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UNITED STATES ATOMIC ENERGY COMMISSION

Nuclear Science Abstracts

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NUCLEAR SCIENCE ABSTRACTS

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ABSORPTION AND SCATTERING OF RADIATION

400 The Angular Distribution of Pair-Produced Electrons and Bremsstrahlung, by P. V. C. Hough. Physical Review 74, p. 80-86, July 1, 1948.

The Bethe-Heitler unscreened cross sections for pair production and bremsstrahlung have been integrated to give the angular distributions. For simplicity, results are restricted to large angles and high energies, but it is shown that extension to smaller angles requires that screening be considered at energies for which screening is important in the usual differential cross sections. The effect of the finite size of the nucleus is estimated and found to be large at the higher energies. It is shown that large-angle pair production will provide only a very small background for single meson production by quanta.

401 The Elastic Scattering of 6.5 Mev Deuterons by Deuterium, Helium, and Other Light Elements, by K. M. Guggenheimer, H. Heitler, and C. F. Powell. Proceedings of the Royal Society 190 A, p. 196-218, 1947.

Methods previously described have been applied to a study of the scattering of 6.5 Mev deuterons by D, He, C, N, O, and Ne. With D, He, and O the elastically scattered deuterons can be clearly distinguished at all angles of scattering from groups of particles due to other nuclear processes. In experiments with these gases it is possible to determine the angular variation of the scattered intensity. In experiments with C, N, and Ne, the peaks in the range distributions due to the elastically scattered deuterons are confused with those produced by protons or α-particles from (d-p) and (d-α) reactions, and the results are less reliable or are confined to restricted intervals in the angle of scattering. Preliminary experiments with A and with a thin Al foil indicated that with these elements the elastically scattered deuterons give rise to the most prominent groups in the range distributions at all angles and that there is no serious confusion arising from the presence of disintegration particles. An appendix on mathematical methods for transforming the observations to the center-of-mass coordinate system is included.

402 The Emission of Protons from Light Nulcei on Bombardment with α-Particles of Short Range, by F. C. Champion and R. R. Roy. Physical Review 74, p. 5-8, July 1, 1948.

The expansion chamber method is used to obtain tracks of protons ejected in 67 disintegrations of fluorine and 121 disintegrations of neon while both gases are under α-particle bombardment. The energetics of the reaction are in good agreement with the mass data, and protons corresponding to transitions to the ground state of the residual nuclei are found with both elements. No disintegrations are detected until the energies of the α-particles reach 3.7 and 4.4 Mev in fluorine and neon, respectively. These are the only energy levels recorded.

The ranges of the protons from fluorine vary within wide limits (an indication of several excited states of the residual nucleus), while those from neon show only one range corresponding to the ground state. In all cases the angular distribution of the ejected protons is anisotropic, and evidence is given that the low energy α-particles responsible for the disintegrations all make off-center collisions and therefore possess angular momentum about the nuclear center. A simple model of the collision process is suggested to account for these results and also for the relative yields which are in the ratio 1:0.5:2 for nitrogen, fluorine, and neon, respectively. A possible cause of the apparent disintegration of nitrogen by α-particles of very low energy is discussed.

ATOMIC POWER

403 Study on the Radioactive-Electric Converter, by Andrew Gemant and Hugh M. Archer. Nucleonics 3, p. 40-45, July 1948.

A design which utilizes grids for the direct conversion of radioactive energy into electric energy is considered from both the electrical and nuclear viewpoint. A calculation is made for the efficiency of a specific design containing one peripheral and four grid electrodes for both cylindrical geometry and spherical geometry.

BIOLOGICAL EFFECTS OF RADIATION

404 The Hematological Effects of Ionizing Radiations, by L. O. Jacobson, E. K. Marks, and E. Lorenz. AECD - 2085 (CH-3864), October 1947, decl. July 1, 1948. 93 p. (To be included in the NNES)

The objectives of the Health Division of the Plutonium Project were essentially: (1) to study the fundamental and comparative biological action of external radiations and internally administered radioactive materials, (2) to apply the findings toward the protection of individuals who worked in the Project, and (3) to use the findings generally for the protection of the public which was potentially in danger of exposure to these physical hazards. The hematologic studies conducted were divided into four main categories: (1) the effects of acute whole body exposure to externally administered penetrating radiations, (2) the effects of chronic whole body exposure to externally administered penetrating radiations, (3) acute toxicity of parenterally and enterally administered radioactive elements, and (4) chronic toxicity of parenterally and enterally administered radioactive isotopes. In order properly to correlate studies on the peripheral blood effects with those occurring in the hemopoietic tissue, the animals in the same or parallel experiments were sacrificed at appropriate intervals for histological study. All experiments included an adequate number of controls, and the frequency of sampling depended upon the chronic nature of the experiment.

405 Comparison of Effects of Mustard, Ultraviolet and X-Radiation, and Colchicine on Cornea, by J. S. Friedenwald, W. Buschke, and Sylvia G. Moses. Bulletin of John Hopkins Hospital 82, p. 312, February 1948.

406 Cytogenetic Effects in Corn Exposed to Atomic Bomb Ionizing Radiation at Bikini, by L. F. Randolph, A. E. Longley, and Ching Hsiung Li. Science 108, p. 13-15, July 2, 1948.

The effective radiations of the atomic bomb were compared with known doses of X-rays with respect to their action in causing direct injury to corn seed and the plants grown from these seeds, and in producing visible chromosomal alterations. The heritability of the induced alterations causing pollen sterility also was studied. The samples of corn included a commercial dent first-generation hybrid of two inbred lines (L289 x I205) and an inbred line of sweet corn (P51). It was concluded from these experiments that with respect to the kinds and frequencies of induced chromosomal alterations, the radiations from the atomic bomb produced effects in corn comparable to those induced by exposure to approximately 15,000 r of X-rays. Both sources of ionizing radiations produced similar phenotypic effects in the plants grown from the irradiated seed, but the bomb produced relatively more chlorophyll deficiencies and dead tissue occurring as sectors than did the treatments with X-rays.

BIOLOGICAL EFFECTS OF RADIATION

407 Effects of Small Daily Doses of Fast Neutrons on Mice, by Titus C. Evans. Radiology 50, p. 811-834, June 1948. (See also MDDC - 1450)

Daily doses of 0.014 "N" of fast neutrons (0.07 "N" per week) equivalent to 0.1 r per day of X rays (on the basis of relative effects of single exposures), had no definite effect on mice treated for approximately eighty-seven weeks. Some effects (though still not pronounced) were observed in animals exposed daily to 0.07 "N" with a total dose of approximately 30 "N". Daily exposures of 0.14 "N" (total of 60 "N") definitely reduced survival time slightly, reduced growth activity of hemopoietic organs and gonads, and slightly increased the frequency of cataracts.

Doses of 1.4 "N" per day resulted in death of over 50 per cent of the animals by about the twenty-ninth week (total "N" = approximately 200). This irradiation caused pronounced changes within a few weeks in blood counts, activity of hemopoietic organs and gonads. In addition, extreme damage to the lens was evident by the time half of the original number of animals had died. Daily exposures of 1.4 "N" were more effective than those of 11 r (equivalents on the basis of relative effects of single exposures). Some effects, based on total dose at time of appearance, indicated a ratio of 12-13 r = 1 "N". The effects of 1.4 "N" per day on gonads and lens were more pronounced than even this ratio, 12 r = 1 "N" would indicate. Considering the results generally, the most important finding was that the lens was especially sensitive to the neutron radiation.

408 The Genetical Effects of Mustard Gas Substances and Neutrons, by A. Gustafsson and J. MacKey. Hereditas Genetiskt Arkiv 34, p. 371-385, 1948.

Dormant seeds of barley were treated with solutions of nitrogen mustard and the effects of this substance were examined in the first and the second generations. The mutation rate after a treatment with 0.01% solution for 40 minutes corresponds approximately to an effect of 1200 r-units. Nitrogen mustard induces a higher mutability than heat treatment or ageing. The mutants appearing are predominantly of the viridis types, albinas being rare.

Neutrons obtained from a cyclotron were applied to dormant seeds. The dosages were measured by a method involving the change of aluminum into a radioactive Na isotope having a half-life period of 14 hours. The β-and γ-radiations were determined, permitting the dosage to be measured in disintegrations per gram Al and per minute. Neutrons distinctly differ from X-rays with regard to their immediate effects. High X-ray dosages decrease the number of mature plants to one or a few per cent, but the average fertility remains at a level of 40-50%. Neutrons give numerous surviving plants after dosages but greatly decrease the fertility. These results are, in the opinion of the authors, dependent on the difference in ion density. In mutagenic action six disintegrations are equivalent to 1 r-unit. Some data indicate a specially wide mutation range in the case of neutrons. The conclusions are drawn that both mustard gas and neutrons may be used with advantage in mutation work dealing with agricultural plants. To a certain extent these agents differ from X-rays in their genetical action.

BIOLOGICAL EFFECTS OF RADIATION

409 The Influence of Chronic Irradiation with Gamma Rays at Low Dosages on the Mutation Rate in Drosophila Melanogaster, by Ernst Caspari and Curt Stern. Genetics 33, p. 75-94, January 1948. (See also MDDC - 1200)

The rate of lethal sex-linked mutations in Drosophila exposed to gamma-rays of 2.5 r units per day through 21 days (total 52.5 r) was determined. In a total of 108,215 chromosomes tested, no significant difference between experimental and controls was found. The difference between experimental and controls found in the present investigation is significantly different (P = 0.012) from that found by Spencer and Stern with the same amount of X-radiation given as one dose. By comparing the present results with those obtained by Spencer and Stern and by Raychoudhuri, it is concluded that it is unlikely that the relative inactivity of the irradiation is due to wave length and temperature of glass containers. As possible causes for the inactivity of irradiation, different sensitivity of sperm at different stages of aging, and dependence of induced mutation rate of low dosages on a time factor are considered. A bibliography of 30 references is included.

410 Nagasaki Survivors as Seen in 1947, by S. Warren. Military Surgeon 102, p. 98, February 1948.

The Atomic Casualty Commission is actively cooperating with the Japanese in a long range study of the surviving population of Hiroshima and Nagasaki. The explosions at Hiroshima and at Nagasaki were air burst so that little of the fission products remained at the site. Instead, they were widely disseminated through the stratosphere. Consequently, all of the bombed area is safe for habitation and for cultivation. The scars of flash burns are relatively frequent among the survivors. Special attention is being given to keloid formation in these scars. The incidence of the keloids appears to be somewhat greater among Japanese than whites, but there is no evidence that there is any specific relationship between the occurrence of keloid in scar tissue and exposure to the explosion of an atomic bomb.

Disturbances of the hemopoietic tissue were evident in 1945, but by 1947 most of the survivers had returned approximately to normal. Up to the present time 3 cases of leukemia, 1 probable case of leukemia, and 1 of multiple myeloma have been reported among the survivors. An abnormal prevalence of monocytes and reticular cells suggests that the marrow in some may not be entirely normal. No tumors of gonads have been reported among the survivors. It will probably to 25 years before reliable data can be obtained on changes in genes.

411 Radiant Energy Injuries, by T. Leucutia. American Journal of Roentgenology and Radium Therapy 59, p. 890-893, June 1948.

In this editorial some of the medical aspects of the atomic bombing of Hiroshima and Nagasaki are considered. Most of the biological damage came from the heat and the radiations, above all from the gamma rays. The author reviews the various types of injuries sustained in the five zones arbitrarily determined by the distance of various sections from the bomb target. The effects of some of the injuries as they appeared two years after the bombing are mentioned briefly.

BIOLOGICAL EFFECTS OF RADIATION

412 A New Theory of the Mechanism of Irradiation Effects, by W. Minder. Radiologia Clinica 16, p. 73-81, 1947.

The results of irradiation of chemical systems of known composition must be considered for the construction of a theory of the biological effects of radiation. This work is an attempt to explain changes brought about by irradition of known mixtures by a simple theory correlating the amount of substance changed by radiation with radiation intensity and time of irradiation.

413 The Problem of Transference of Energy in Biological Irradiation, by W. Minder. Radiologia Clinica 15, Supplement, p. 81-85, 1946.

The effects of irradiation on substances of known chemical composition in aqueous solutions are exerted in a round about way through the agency of the solvent, water. A transference of energy must take place from the H_2O molecules activated by the radiation to the dissolved substance. As a result of radiation below 25°, 35°, and 50° respectively, solutions of bromoform, ortho-dichloro-benzene and ferrous sulphate in water show no temperature coefficient of reaction. Irradiation with X rays on radium does not affect frozen (solid) solutions. This shows that the energy-transfer and therefore the radiation effect is only possible where there is freedom of molecular movement (diffusion).

414 Ocular Lesions Following Atomic Bombing of Hiroshima and Nagasaki, by J. J. Flick. American Journal of Ophthalmology 31, p. 137, February 1948. (See also MDDC - 936)

The author describes ocular lesions which are directly related to deficiency in blood elements and in no way directly related to the action of radiant energy on the eye. The location of these lesions near large vessels is explained by the increased intra-vascular pressure in vessels of large size. The ocular lesions were observed to disappear without residual damage to the eyes in those persons who recovered from the hemopoietic depression.

415 Preliminary Observations on the Effects of Irradiation upon the Chylomicrons in Human Blood, by Kai Setala. Radiology 50, p. 803-809, June 1948.

An attempt was made to determine the effects of roentgen or radium rays on the mobile visible lipids in human blood following administration of a fatty meal and before the lipids were deposited in the tissues. As a method of investigation, instead of quantitative chemical determinations, which are subject to considerable error, chylomicron counts were obtained at half-hour intervals. Observations were made on 32 individuals, and every precaution was taken to avoid the possibility of error.

It was found that irradiation regularly produced changes in the amount and metabolism of the visible blood lipids. Further it was found that, to produce changes, the irradiation must be done within a given time interval after the ingestion of the fatty food. It appeared, also, that irradiation of certain regions of the body, as the abdomen, the pelvis and the bifurcation of the common carotid was followed by a particularly marked effect.

(Cont'd on next page)

BIOLOGICAL EFFECTS OF RADIATION

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With the histamine theory in mind, the effect of intramuscular injections of histamine acid phosphate was also investigated. Such injections, suitably timed in relation to the fatty meal, effected changes in the lipid metabolism comparable to those following irradiation. In persons with symptoms of radiation sickness, the changes in the blood lipids were particularly severe. It is assumed that the decrease and/or disappearance of the mobile visible lipids observed in these studies is an effect of hemoconcentration due to increased permeability of the capillaries caused by irradiation or histamine administration.

416 Dosage Levels in Administration of Isotopes to Animals and Man, by Hermann Lisco. United States Naval Medical Bulletin, March-April 1948. Supplement, p. 161-163.

Radioactive isotopes have injurious effects upon animals and man. These effects are functions of a number of factors, two of which are the half-life and the distribution of the isotope in the body. Since the distribution varies from isotope to isotope, depending upon metabolic function, turnover, and excretion rates, different manifestations of radiotoxicity can be expected. Laboratory studies have provided information on the ranges of dose levels in animals at which acute and chronic injurious effects can be expected. Isotopes studies include Sr^{89}, Y^{91}, Ra, Ce^{144}, P^{239}. Although this list does not include isotopes commonly used for tracer studies, certain conclusions may be drawn from the data which have been obtained.

Studies of P^{32} and C^{14} are now being carried out. Virtually nothing is known at present about the distribution of C^{14} in the mammalian body and its retention in and toxicity to the organism. Some preliminary data suggest, however, that some retention does occur in bone and this fact should be borne in mind by investigators using C^{14}.

There is information on dose levels of P^{32} and I^{131} presently used in man for treatment of disease, and the blood picture (lymphocytes, platelets) is a fairly accurate and reliable indicator of incipient radiation damage. However it will be exceedingly difficult to detect minute quantities of radioactive isotopes lodged in discrete areas in the body and producing localized irradiation over a long period of time without concomitant damage to the bone marrow. It has been tacitly assumed that tracer levels of radioactive isotopes have no effects upon the systems under investigation. Although this is probably true in most instances, it might be worth considering a number of ad hoc experiments, so that definite information may become available on tolerance-levels as applied to animal experiments of this type.

BIOLOGY, GENERAL

417 Distribution and Excretion of Plutonium, by E. R. Russell and J. J. Nickson. MDDC - 503 (MUC-ERR-209), June 11, 1946, decl. July 7, 1948. 20 p. (To be included in the NNES)

The primary objectives of this work have been the development of analytical methods for the determination of submicro amounts of plutonium in excreta and from the data obtained calculate the plutonium body content of individuals working with or exposed to the element. The excretion rate and the distribution of plutonium in the various tissues have been determined. The rate of excretion of plutonium in the urine was nearly 0.01% per day of that contained in the body. Observations running beyond 155 days indicate that the excretion rate may be slightly lower after this period.

BIOLOGY, GENERAL

418 The Lymphocyte; Studies on Its Relationship to Immunologic Processes in the Cat, by Charles G. Craddock, Jr., William N. Valentine, and John S. Lawrence. AECD - 2095 (UR-32), n.d., decl. July 9, 1948. 44 p.
(For publication in the Journal of Laboratory and Clinical Medicine)

The experiments were designed to study the antibody content of thoracic duct lymphocytes in cats during the stage of active antibody production, and to determine the effect of lymphoid tissue damage on the formation of antibody and its transport to the blood by lymph. The experimental background for the concept of antibody formation by local lymphoid tissue which has taken up an injected antigen, and transport of antibody to the blood by lymphocytes produced in this nodal tissue, is reviewed. The significance of the concept of pituitary-adrenal cortical control of lymphoid tissue structure and function, particularly in regard to antibody formation, is discussed.

The experimental technique for the demonstration of antibody in lymphocytes was essentially to collect all thoracic duct lymph at specific intervals over an 8-10 hour period during the time of active antibody production. The antigen used was typhoid vaccine, injected into the subcutaneous area of the back, and intraperitoneally. No evidence of significant amounts of antibody in lymphocytes could be found either in extracts of washed lymphocytes or by comparing the relative antibody content of cell-free lymph fluid with that of lymph containing large numbers of lymphocytes. In every case, however, a significant antibody for either typhoid "H" or typhoid "O" antigen was present in the blood serum and the cell-free lymph fluid.

Exposure of a group of immunized cats to 1500 r whole-body X ray during the time of lymph drainage, failed to alter significantly the antibody concentration of the cell-free lymph in spite of a marked decrease in the numbers of thoracic duct lymphocytes. The blood serum antibody titre rose significantly in 50 per cent of the animals during the time of lymph drainage. It was concluded that this continued rise in serum antibody titre was probably not due to transport of antibody via the remaining lymphatic channels. The continued rise of serum antibody titre was not considered to be due to continued antibody production by lymphoid tissue in those animals exposed to X ray. Administration of large doses of adrenal cortical hormones to a small group of animals failed to alter the antibody concentration of cell-free lymph.

It is concluded that, under the conditions of the experiment, significant amounts of antibody were not detected in thoracic duct lymphocytes. Transport of antibody by lymphocytes did not appear to be essential for an elevation of blood antibody titre to occur. Production of antibody by lymphoid tissue must be further elucidated before it can be considered of primary importance in this regard.

419 Medical and Health Division Quarterly Report, January, February, March 1948. Part II. Biological Studies of Radiation Effects, by University of California Radiation Laboratory. AECD - 2099 (UCRL-98), May 28, 1948, decl. July 9, 1948. 31 p.
(For publication in Radiology)

This report consists of two papers numbered AECD - 2099-A and AECD - 2099-B respectively. Tnese papers are individually abstracted below.

BIOLOGY, GENERAL

419-A The Radiological Use of High Energy Deuteron Beams, by Cornelius A. Tobias, Hal Anger, P. P. Weymouth, and R. Lowry Dobson. AECD - 2099-A, May 28, 1948, decl. July 9, 1948. 19 p. Document for sale by AEC.

The suitability of the 190 Mev deuteron beam as a source of radiation for producing biological effects was investigated. There is a good indication that fast particle beams will become precision tools in the study of the biological effects of radiation and in experimental tumor therapy. The lethal effect of the high energy deuteron beam on Bagg Albino mice was measured. The LD 50 was 150 rep when the length of exposure was 15 seconds. The LD 50 appeared to change approximately proportionately to the fourth root of the length of exposure time.

419-B Analysis of Micro-Composition of Biological Tissue by Means of Induced Radioactivity, by Cornelius A. Tobias and Rayburn W. Dunn. AECD - 2099-B, May 28, 1948, decl. July 9, 1948. 12 p. Document for sale by AEC.

A technique for the analysis of inorganic microcomponents of biological tissue by means of induced radioactivity is described. Theoretical implications of this technique and its connections with radioactive tracer methods are discussed. Preliminary data on the radioactivities found in a set of neutron-irradiated tissue ash sample are reported.

420 Initial Studies of the Inhalation Toxicity of Beryllium Sulfate Tetrahydrate Dust, by George F. Sprague. AECD - 2102 (UR-31), n.d., decl. July 9, 1948. 25 p. Document for sale by AEC. (Disposition as required for use in research, development, or manufacturing work) (See also MDDC - 1318)

Data have been collected and evaluated on 2 dogs, 10 rats, 3 rabbits, 14 guinea pigs, 20 mice and 7 hamsters exposed to a high, daily concentration of $BeSO_4 \cdot 4H_2O$ for 11 days or 66 exposure hours. The most striking feature of the study was the marked species difference with respect to most of the criteria of toxicology employed. Thus all of the 20 mice died before the termination of the experiment; the histologic findings showed pulmonary damage in all of the species, hepatic damage in the mice, ocular lesions in the guinea pig and dog, and renal necrosis in the rabbit and rat. The micropathologic findings confirmed the biochemical observation that a renal impairment followed by regeneration had occurred in the rabbit; however, the clinical chemical observations failed to reveal any significant indication of renal or hepatic injury in the dog.

The only consistent result observed in all species was the marked rise of the leukocyte and absolute neutrophil count in the dog, rabbit and rat. The erythrocyte count for the three species was most constant throughout the period of exposure. The effect of the acidic sulfate anion on the acute toxicity of beryllium, while it may enhance the characteristic beryllium lesion in some instances, is felt not to be the principal beryllium sulfate response. Such responses as were observed are believed to be typical of beryllium itself.

BIOLOGY, GENERAL

421 Delayed Chemical Pneumonitis or Diffuse Granulomatosis of the Lung Due to Beryllium, by Stanley A. Wilson. Radiology 50, p. 770-779, June 1948.

An effort has been made to present all phases of a problem which is not completely solved. The recognition of the roentgen manifestations of the pulmonary changes in beryllium workers is most important. A description of these changes and some of the differential diagnoses have been included. Detailed description and presentation of case histories have been omitted. The object of this presentation is to bring to the attention of industrial physicians and radiologists the existence of an occupational hazard.

422 Origin of the Antibiotic Obtained by Irradiation of Ammonium Lactate With Radium, by F. Chodat and A. de Yakimach. Archives des Sciences Physiques et Naturelles, 28, Suppl. 63, p. 143-144, 1946.

When a synthetic medium containing NH_4 lactate, $MgSO_4$ and K_2HPO_4 is irradiated with radium it gives rise to an antibiotic substance which inhibits the growth of gram-negative organisms such as E. coli, and Ps. fluorescens. The presence of NH_4 lactate is essential to the production of the antibiotic, but in the absence of both the other constituents no effect is observed. NH_4 lactate and $MgSO_4$ alone give a somewhat less positive result and NH_4 lactate and K_2HPO_4 only a feebly positive result. The chemical nature of the antibiotic is as yet completely unknown.

423 Pathogenic Action of Thorium Dioxide, by Amandio Tavares and Ernesto Morais. Trabajos del Institute Nacional de Ciencias Medicas 6, p. 253-274, 1945-1946.

Malignant tumors may be produced in white rats by injections of thorotrast which accumulates in tissues destroying them mechanically, as well as causing inflammation with intense proliferation of histocytes. Cellular elements are destroyed and the collagen undergoes hyaline degeneration as fibrosclerotic changes progress. Superimposed infection may become very severe.

424 Toxicity of Inhaled or Ingested Radioactive Products, by Waldo E. Cohn. Nucleonics 3, p. 21-26, July 1948. (See also MDDC - 1656)

A general formulation is presented which permits the calculation of radiation dosage consequent upon inhalation or ingestion of radioactive material in terms of physiological behavior of the materials, nature of source and type of radiation emitted.

425 X-Ray Diffraction Studies in Biology and Medicine, by Mona Spiegel-Adolf and George C. Henny. New York, Grune and Stratton, 1948. 222 p.

CERAMICS

426 Ceramic Group Explores High Temperature Application. Iron Age 162, p. 86-89, July 8, 1948.

The 50th annual convention of the American Ceramic Society was held in Chicago recently. Emphasis was placed on the importance of pure oxide refractories and ceramic-metal combinations in jet propulsion, rocket and atomic energy programs. Papers presented at the meeting are briefly reviewed.

427 Ceramics and Nucleonics, by A. L. Johnson. American Ceramic Society Bulletin 27, p. 235-237, June 15, 1948.

An account is given of the part played by the science of ceramics in the development of the atom bomb. Extensive research was carried out on refractory oxides, nitrides, and sulfides to determine the properties of these materials, and how they could be used effectively in releasing nuclear energy.

428 Metal Ceramics, by H. H. Houser. Metal Industry 72, p. 405-407, May 14, 1948.

The latest developments in the field of powder metallurgy are discussed.

CHEMISTRY, ANALYTICAL

429 The Quantitative Spectrographic Analysis of Beryllium and its Compounds, by A. Lee Smith and Velmer A. Fassel. AECD - 2100, n.d., decl. June 22, 1948. 18 p. (For publication in the Journal of the Optical Society of America or Analytical Chemistry)

A method is described for the simultaneous quantitative spectrographic determination of aluminum, calcium, chromium, iron, manganese, magnesium, and silicon in beryllium and its compounds. The procedure involves the conversion of the sample to beryllium oxide and the addition of a mixture of graphite powder, tin oxide, and barium hydroxide. The mixture serves for internal standard and arc stabilization purposes. A high amperage dc arc is used for excitation. The accuracy of the manganese and iron calibrations was established by comparisons with results obtained by independent spectrophotometric procedures. The experimental error is about $\pm 5\%$ of the amount present. The method should be readily adaptable to the determination of other metallic impurities in beryllium metal or its compounds.

430 The Chemical Separation of the Element Originating in Uranium Fission, Part II, by W. Seelmann-Eggebert. Zeitschrift fur Naturforschung 2a, p. 569-572, October 1947. (In German).

A description is give of analytical procedures for separating Ru, Rh, Pd, Ag, Cd, and In.

CHEMISTRY, ANALYTICAL

431 Quantitative Analysis with the X Ray Spectrometer, by Harold P. Klug, Leroy Alexander, and Elizabeth Kummer. Analytical Chemistry 20, 607-613, July 1948.

Preliminary performance tests are reported for the Norelco Geiger-Counter X-ray spectrometer with respect to reproducibility of measurements and accuracy in quantitative analysis of powder mixtures. Specimen preparation is discussed, and the necessity for avoiding large crystallities in the powder is indicated. The reproducibility with the automatic recorder appears not to be good enough for precise quantitative work. Manual counting in a single scanning usually permits the determination of quartz, in mixtures containing more than 10% quartz, with an average accuracy of about ±5% of the absolute amount present. Higher accuracy can be attained by several scannings.

432 Spectrochemical Analysis, by F. Twyman. Research 1, p. 388-393, June 1948.

A review article discussing the application of spectrochemistry to the analysis of metals and alloys, metallic traces in non-metallic substances, and compounds. 18 references.

CHEMISTRY, GENERAL

433 Preparation of 1-C^{14}-Propene-1 and the Mechanism of Permanganate Oxidation of Propene, by B. A. Fries and M. Calvin. Journal of the American Chemical Society 70, p. 2235-2240, June 1948. (See also MDDC - 1701)

1-C^{14}-propene-1 has been prepared. The migration of the double bond under a variety of experimental conditions in the preparation of propene has been investigated. The mechanism of the permanganate oxidation of the labelled propene has been examined. It has been found to proceed by several paths the relative importance of which depends upon the experimental conditions, especially the pH.

434 Separation of Iodine-131 from Tellurium by Milton Levy, Albert S. Keston and Sidney Udenfriend. Journal of the American Chemical Society 70, p. 2289-2290, June 1948.

The irradiated unit supplied by the U. S. Atomic Energy Commission as a source of I^{131} contains 50 g of tellurium. The chromic or nitric acid oxidations such as have been used in the purification of cyclotron targets proved cumbersome in the case of the pile units because of the large amount of tellurium. A purification method based on fusion with sodium hydroxide has proven rapid and reliable. The method is described in detail. The yield was found to be 85-95% of the I^{131} originally present.

CONTROL OF ATOMIC ENERGY

435 The Physicist and the Future Development of Atomic Energy. American Journal of Physics 16, p. 326, May 1948.

This is a summary of a speech by Robert F. Bacher given before the American Physical Society, New York, January 30, 1948. He outlines the primary duties of the Atomic Energy Commission as the production of fissionable materials; the development, production, and testing of atomic weapons; the development of nuclear reactors; and basic research in the fundamental sciences underlying nuclear energy.

CORROSION AND ANTI-CORROSION

436 Corrosion Inhibitors in Theory and Practice, by Robert D. Misch and Hugh J. McDonald. Wire and Wire Products 23, p. 221-226, 260-264, March 1948.

The mechanism of inhibtor action is discussed on the basis of present knowledge. A review the applications of inhibitors is included. 36 references are given.

437 The Mechanism of the Corrosion of Aluminium, J. M. Bryan. Chemistry and Industry, p. 135-136, February 28, 1948.

The properties of the oxide film of aluminium are discussed in relation to the known facts concerning aluminium and the electrochemical theory of corrosion. The author suggests a modification of the usual electrochemical explanation to account for the behavior of aluminium in alkaline solution.

438 Metals for Use with Highly Corrosive Media. Materials and Methods 28, p. 87-89, July 1948.

A two page chart is presented listing the principal corrosion resistant metals.

COSMIC RADIATION

439 A Counter Apparatus for the Measurement of Cosmic Rays, by M. Miesowicz and L. Jurkiewicz. Acta Physica Polonica 9, p. 54-58, 1947.

A description is given of the preparation and filling of large G-M counters of metal construction and of tests of the life of the counters at high counting rates.

COSMIC RADIATION

440 Experiments on the Separation of Low Energy Mesotrons from Electrons, by P. C. Bhattacharya. Physical Review 74, p. 38-43, July 1, 1948.

For the separation of low energy mesotrons occuring in cosmic radiation from electrons a block of lead 1.25 cm thick was placed above a pair of anticounters such that any electron which generates a shower in it is removed by the anticounters. An additional block of lead was also placed below the anticounters to absorb any electron which escaped the system without producing a shower in the upper lead piece. The mesotrons thus separated from the electrons were examined in a Wilson chamber having a 2-cm block of lead across the center. 937 single tracks were observed to traverse the 2-cm lead block and all these tracks were ascribed to mesotrons. There was a case of a shower of three particles found to be generated in the lead piece inside the chamber and this shower was attributed to a knock-on process. It was also found that the additional lead block whose thickness was to be 4 cm, according to Bhabha, could be reduced to 2 cm at sea level without disturbing the efficiency of the system. By an experiment with counters it was also found out that 1.25 cm of lead corresponds to the maximum for shower of two or more particles initiated only by electrons in lead.

441 Investigation of the 27-Day Period of Cosmic Radiation, by H. Gheri and R. Steinmaurer. Acta Physica Austriaca 1, p. 42-54, 1947. (In German).

Using an ionization chamber shielded with 10 cm of Pb and 7 cm of Fe, the phase and amplitude of the 27-day period of cosmic radiation was studied. The results are compared with the theoretical treatment by Vallarta (based on the inclination of the magnetic and rotational axes of the sun). The effects of solar activity and variations of the earth's magnetic field are also examined.

442 Mass Temperature Coefficient of Cosmic-Ray Components, by F. M. Millican and D. H. Loughridge. Physical Review 74, p. 66-70, July 1, 1948.

The temperature pressure curve from U. S. Navy Raob data was integrated by an empirical formula determined graphically. The resulting average "mass temperature" of various fractions of the atmosphere was correlated by a method of least squares with the vertical cosmic-ray intensity of three components, hard, medium, and soft, shielded by 30.5, 20.5, and 0.5 cm of lead, respectively. The temperature coefficient was found to be an increasing function of the fraction of the atmosphere for larger fractions. The temperature coefficients obtained for the fractions 1, 3/4, 6/10, and 1/4 are for the hard component: -0.25 ± 0.06, -0.18 ± 0.04, -0.15 ± 0.04, and -0.17 ± 0.04 per cent degree centigrade, respectively. The results for the medium component are: -0.61 ± 0.11, -0.43 ± 0.07, 0.34 ± 0.08, and -0.39 ± 0.08 per cent per degree centigrade, respectively. Comparative results for data from a Millikan-Neher electroscope shielded by 12 cm of lead are: -0.25 ± 0.05, -0.17 ± 0.03, -0.16 ± 0.03, and -0.17 ± 0.03 per cent per degree centigrade for the respective fractions listed above. The results for the soft component correlated so poorly that no values are quoted.

COSMIC RADIATION

443 Narrow Showers at Sea-Level, by A. Alichanian and N. Shostakovich. Journal of Physics U.S.S.R. 10, p. 518-522, 1946.

A determination was made of the transverse dimensions and penetrating power of narrow showers. They are practically equally decreased when traversing the same mass of Pb or Fe. The law governing the absorption of the particles of the showers in Pb is completely different from that for the electrons of the soft component. Narrow showers consist of particles with a completely different penetrating power from electrons, although the shower may include electrons.

444 On the Penetrating Showers of Cosmic Radiation, by G. Cocconi and K. Greisen. Physical Review 74, p. 62-65, July 1, 1948.

Experiments have been performed on the penetrating showers of cosmic radiation accompanied and not accompanied by extensive air showers. In the accompanied showers the penetrating particles are very likely to pre-exist in the air; in the unaccompanied showers they are created in the absorbers surrounding the counters by a nucleonic component of the cosmic radiation.

445 Positive Excess of the Mesonic Component at Sea Level and at Various Zenital Altitudes, by C. Ballario, M. Benini and G. Calamai. Nuovo Cimento 5, p. 187-195, June 1, 1948. (In Italian).

Measurements have been taken of the mesonic component positive excess at sea level and at different zenital heights by using a counter telescope having magnetic lenses. Another series of measurements has been carried out for particles of both signs at various zenital heights, the first lens being a converging and the second one a diverging lens. Effects $\sigma+$ and $\sigma-$ showing the percentage of positive and negative particles of rather slow energies (3.5×10^8 ev) in the mesonic spectrum have been calculated. If a positive excess of 20% uniformly distributed in the energy spectrum is assumed, experimental results for δ, $\sigma+$ and $\sigma-$, and a comparison with the calculations made lead the authors to believe that the excess is not uniformly distributed, but decreases with an increase of meson creation energy. The experimental results obtained indicate that the multiplicity of creation by protons must increase with the creation energy of the mesons, or that there is a considerable creation process by a non-ionizing radiation.

CRYSTALLOGRAPHY

446 The Crystal Structure of Th_2N_3, by W. H. Zachariasen. AECD - 2090 (ANL-FWHZ-157), January 19, 1948, decl. June 28, 1948. 4 p. (For publication in Acta Crystallographica or similar journal)

A preparation of thorium nitride is found to be hexagonal with $a_1 = 3.875 \pm 0.002$ A, and $a_3 = 6.175 \pm 0.004$ A. The unit cell contains two thorium atoms at $\pm (\frac{1}{3}, \frac{2}{3}, u)$ with $u = 0.250 \pm 0.015$. It is shown that the compound in all probability is Th_2N_3 and that it has the La_2O_3 type of structure. Thus the probable nitrogen positions are: 1 N at (0 0 0), 2 N at $\pm (\frac{1}{3}, \frac{2}{3}, v)$ with $v = 0.63$. Each thorium is bonded to seven nitrogen atoms with an average distance Th-N = 2.51 A.

CRYSTALLOGRAPHY

447 New Crystal Structure Results, Part I, by W. H. Zachariasen. AECD - 2093 (ANL-FWHZ-164), April 19, 1948, decl. June 28, 1948. 14 p. (For publication in Physical Review or similar journal)

This paper is the first of a series of articles summarizing crystal structure results which the writer has obtained in the course of the last five years, results which have not yet been reported in the open literature. This first paper gives brief descriptions of the complete crystal structures of sixty-two different compounds corresponding to eighteen new structure types. All of the structures described in this article were deduced from X-ray diffraction patterns of crystal powders. Only in two instances, $PuCl_3$ and Na_3UF_7, did single crystals later become available so that the conclusions reached from a study of the powder diffraction patterns could be confirmed by means of single crystal patterns of the Weissenberg type. The information given about the various structures includes the unit cell dimensions, the number of stoichiometric molecules per unit cell (n), the space group, the atomic positions and the interatomic distances.

448 On the Temperature Dependence of the Intensity of Electron Diffraction of the Aggregate of Minute Crystals; a Possible Means to Determine the Cleavage of Minute Crystals, by Shigeto Yamaguchi and Tominosuke Katsurai. Journal of Colloid Science 3, p. 255-258, June 1948.

A special camera was constructed for the study of electron diffraction at high temperature, Fe_3O_4, ThO_2, Ni and MgO powder crystals being used. From the change of the intensity of diffraction from various planes taking place at various temperatures, the cleavage faces of the powder crystals can be determined.

DEUTERIUM

449 Improved Preparation of Deuterium Organic Compounds by Exchange, by Klaus Clusius and Herbert Knopf. Zeitschrift fur Naturforschung 2b, p. 169-173, 1947.

The effect is discussed of the concentration, the mass action constant K, and the number of the single operations on the preparation of deuterium compounds by exchange with heavy water. By combination of the exchange equivalent, in which K is of the order of magnitude of 1, with a rectification of the mixture resulting from the exchange H_2O-HDO-D_2O, compounds with a high percentage of deuterium can be obtained in one step. The results of such a rectification are described.

DIFFUSION

450 **A Diffusion Problem in which the Amount of Diffusing Substance is Finite. Part IV, Solutions for Small Values of the Time, by J. Crank. Philosophical Magazine 39, p. 362-376, May 1948.**

This paper is one of a series concerned with diffusion problems in which the amount of diffusing substance is finite. Diffusion is considered to take place along capillaries within a plane sheet or a cylinder, and to be accompanied by adsorption on the walls of the capillaries. Equations are developed for diffusion into a lamina and into a circular cylinder of infinite length and fixed radius by both linear and non-linear adsorption.

Nuclear Science Abstracts supersedes two previous AEC abstract journals, Abstracts of Declassified Documents and Guide to Published Research on Atomic Energy. No copies of the latter journal are available. Back issues of the Abstracts of Declassified Documents may be purchased from the Document Sales Agency.

HEALTH PROTECTION

451 Contamination of Water Supplies by Radioactive Substances, by J. Carrell Morris and Jeanne B. Carritt. Journal of New England Water Works Association 62, p. 1-9, 1948.

All radiations due to atomic disintegrations are toxic to living tissue whether they are the result of direct exposure or are absorbed into the body cells or fluids. General body radiation causes toxicity either through destruction of body cells by γ-rays, or where neutrons are present, by destruction of the tissues. Various types of action are discussed. Water contamination maybe due to induced radioactivity, presence of radioactive chemical wastes, atomic bomb explosion, or sabotage. Several methods of removal are suggested, such as ion-exchange treatment with filtration and deaeration. Modifications of coagulation processes are mentioned.

452 Hazards Presented by Radioactive Materials and How to Cope with Them, by Karl Z. Morgan. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 142-160.

Radiation is defined as damaging only when it is absorbed in sufficient amount to bring about observable and undesirable body changes. Damage may result from external or internal radiation exposure or from a combination of both. The effective body elimination constant, λ, is considered to be the sum of the radioactive decay constant, λr, plus the biological elimination constant, λe. The amount of the various radioisotopes in the body can be estimated from an examination of the various body excretions or from an analysis of the body fluids and tissues. The best protection from radiation damage is to avoid overexposure.

Two types of instruments, survey and personnel monitoring, are necessary if work is undertaken where radiation exposure is possible. Fiber electroscopes are considered to be the most reliable survey instruments at present and both films and air condenser meters are recommended for personnel monitoring. An instrument for determining the radioactive material suspended in the air is usually necessary, and special instruments to measure the radioactivity of waste solutions are essential for larger operations. Geiger-Muller counters are very useful indicating instruments, but should not be used to obtain quantitative information. Special consideration should be given to the design of buildings and equipment that are suitable for work with radioisotopes rather than to improvise inadequate facilities. Two units used extensively on the Atomic Energy Projects because of their convenience are the rep and the rem. The rep is defined as the quantity of radiation that is absorbed at the rate of 83 ergs per gram of tissue and the rem is that quantity of radiation (α, β, γ, protons, neutron, etc.) that produces the same damage to man as one roentgen. Tolerance to all forms of radiation is considered to be 100 millirems per day. This tolerance value is actually the maximum permissible daily dose and it is recommended that in practice the average radiation exposure should not exceed one tenth of this value. Equations are given for calculating the tolerance concentrations of radioactive material in the body.

453 Industrial Health Engineering, by Allen Demmy Brandt. New York, Wiley, 1947. 395 p.

HEALTH PROTECTION

454 Laboratory Handling of Radioactive Material; Protection of Personnel and Equipment, by Paul C. Tompkins. United States Naval Medical Bulletin, March-April 1948. Supplement, p. 164-175. (See also MDDC-1527)

Both personnel and equipment must be protected from an undesirable high intensity of external radiation and from adverse results due to radioactive contamination. Radiation protection is provided by a combination of distance and massive shielding between the source and the operator or instrument. Contamination control is provided by the development of aseptic technique. To accomplish the latter, steps must be taken to keep active material confined to the interior of the equipment and provision must be made for the detection, removal, and subsequent disposal of any active material that gets outside the equipment. Techniques which have been developed to accomplish the above in such operations as sampling, preparation of experimental solutions, evaporation, filtration, and injection of radioactive materials are described and illustrated.

455 Medical Aspects of an Atomic Disaster Plan, by E. Richard King. United States Naval Medical Bulletin, March-April 1948. Supplement, p. 185-204.

In considering the subject of the medical aspects of an atomic catastrophe, the following points are considered the most pertinent:

An organizational plan for an atomic disaster should be set up, with full cooperation of the medical profession and military and civilian organizations. Training of medical and lay personnel in the effects of ionizing radiation, and preparations for a possible atomic disaster are of immediate importance. Training of special technicians in both the civilian and the military organizations is also important. Proper handling of an emergency by the doctor can best be performed if channels of communication and transportation remain open between the devastated areas and relief stations. Each city and large military base should have a number of potential blood banks, fully equipped, in its suburban areas or periphery. Dressing stations and decontamination stations should be established in the outlying areas of location of a potential explosion.

A program of decentralization of industry, government and military establishments should be instigated, with dispersion of housing and hospital facilities some distance from these locations. The problem of maintaining a water supply, not dependent upon lakes and rivers which are easily contaminated with radioactive materials, should be studied. Storage sites of non-perishable foods and medicinal supplies with adequate protection from radiation, and within easy reach of above-mentioned blood banks, dressing stations, and decontamination centers should be planned and established. An adequate supply of special clothing for rescue workers and of specially adapted masks for all workers and possible exposed personnel should be procured and be available for instantaneous use.

Urban areas and military bases should practice organized drills in use of above equipment, and in evacuating a city or an exposed military base. These drills should employ the use of masks, detection instruments, protective clothing and simulate rescue and decontamination measures. The civilian personnel of the country, and civilian workers at military bases, should have an adequate background so that they may relieve the military in a large number of these tasks. Further investigations should be carried out in the problem of atomic defense, shielding of radiation, protective clothing, and treatment of radiation sickness.

HEALTH PROTECTION

456 Radiation From a Flask Containing Various Amounts of Radioactive Phosphorus, by Russell F. Cowing and Egilda De Amicis. Science 107, p. 684, June 25, 1948.

The handling of radioactive phosphorus becomes a radiation hazard if not properly executed. To substantiate the existance of this radiation hazard, measurements were taken of the radiation emitted from a 125-cc Erlenmeyer flask containing 100 cc of distilled water to which various amounts of P^{32} were added. A table is given which shows the relation between various concentrations of P^{32} and the average milli-roentgens per hour at several distances. A guide is included for determining the length of time a flask of this type can be safely handled when it contains various concentrations of radioactive phosphorus.

457 Rules and Procedures Concerning Radioactive Substances and Associated Hazards. U. S. Atomic Energy Commission, Clinton Laboratories, February 1947. 30 p. (PBL 92185)

The presently accepted rules and procedures which are considered necessary for the safe conduct of operations at the plant site are made available in this report. Topics covered are tolerance; radiation monitoring; protective clothing and devices; eating and smoking rules; contamination of persons; contamination of areas; storage handling and disposal of radioactive materials; and summary of enforcement responsibilities.

INSTRUMENTS

458 Trochotron Design Principles, by G. W. Monk and G. K. Werner. AECD-2096 (Y-124), February 3, 1948. Decl. July 9, 1948. 16 p. (For publication in Review of Scientific Instruments)

A simple derivation of the perfect focussing properties of the trochoidal type mass spectrometer is given which leads to convenient methods of correlating the many variables for design purposes. Nomographs and general trochoids are given which apply to charged particles in crossed, uniform electric and magnetic fields.

459 Counter Design for Gaseous Weak Beta Emitters, by Joseph T. Kummer. Nucleonics 3, p. 27-28, July 1948.

A thin-window Geiger tube for counting gaseous samples when C^{14} is used as a tracer has been designed. A diagram of the instrument is included and typical operating data is given.

INSTRUMENTS

460 Geometric Factors Underlying Coincidence Counting with Geiger Counters, by Homer E. Newell, Jr. Review of Scientific Instruments 19, p. 384-389, June 1948.

The coincidence rate of a perfectly efficient two-counter telescope embedded in an isotropic field of radiation is obtained in terms of the radiation intensity and the effective dimensions and separation of the counters comprising the telescope. By means of the formulas the counting rate may be located between an upper and a lower bound which in most practical cases differ by only a few per cent. The information embodied in the formulas is also presented graphically in a form convenient for ready calculation of the ratio of coincidence rate to radiation intensity once the effective dimensions and separation of the two counters are known.

461 An Inside Geiger-Müller Counter for Soft Beta-Emitters, by L. W. Labaw. Review of Scientific Instruments 19, p. 390-395, June 1948.

A pratical inside Geiger-Müller counter for the detection of soft beta-rays and alpha-particles is described in conjunction with a simplified method for the preparation of samples for assay. The method for radioactive assay used is tested for reproducibility and accuracy. Direct determination of the specific activity of samples having different chemical composition can be made simply without an initial chemical extraction of the active element.

462 A New Mass Spectrometer for Isotope-Ratio Measurements, by Harold W. Washburn. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 60-81.

A 60° sector type mass spectrometer developed by Nier for isotope ratio measurements has been redesigned to give ease of operation and servicing, and dependability of operation. It is expected that it will find wide use in the biological, chemical, and petroleum fields for tracer work and for analysis by the isotope dilution method. This mass spectrometer has a mass range from 2 to 80. In the mass range from about 14 to 80, it operates as a double exit slit instrument. This double slit feature permits the determination of isotope ratios by a very simple procedure. After the sample is introduced, the isotope ratio is read from a set of dials which are adjusted to give a null reading on a galvanometer. In addition to simplifying the procedure, the double exit slit arrangement materially reduces some of the errors inherent in measurements made by bringing each peak successively to a focus on a single exit slit. As a result, the determination of the isotope ratio in the mass range of 14 to 80 can be made with an accuracy of $\pm$ 0.2 per cent. This high accuracy of determination of ratios permits detection of excess isotope for dilutions as high as 5000 for initial material 10 per cent enriched in tracer isotope. Higher dilutions are detectable with higher percentage enrichments. The limit is 50,000 for initial material containing 100 per cent tracer isotope. The sample required for analysis is very small since the rate consumption is only 2 cc of gas at standard conditions per 24 hours.

463 Theory and Operation of Geiger-Müller Counters, Part I, by Sanborn C. Brown. Nucleonics 2, p. 10-21, June 1948.

An understanding of the characteristics of Geiger-Müller counters is essential for their proper use. The author discussed the breakdown characteristics of the discharge for simple and polyatomic gas counters, properties of gas fillings, need for and method of quenching a discharge, relationship between pulse size and plateau, the nature and effect of spurious discharges, and probable life of gas filling.

INSTRUMENTS

464 The Use of the Double Crystal Spectrometer in the Analysis of Bragg Reflections at Very Small Angles, by Paul Kaesberg, H. N. Ritland, and W. W. Beeman. Physical Review 74, p. 71-73, July 1, 1948.

A two-crystal spectrometer has been used to investigate X-rays scattered from the large periodicities in wet collagen. Positions and relative intensities are assigned to the first through the seventh orders and to the ninth order. Some advantages of this method over the usual diffraction methods are pointed out.

ISOTOPES

465 Isotopes Chart. Chemical and Engineering News 26, p. 2162, July 19, 1948.

A chart of the most recent data concerning various isotopes has been prepared by G. Friedlander and M. L. Perlman for distribution by the General Electric Co. Following the general pattern of that previously devised by Emilio Segre, it starts on the left with hydrogen, heavy hydrogen appearing in the next square to the right; helium 3 appears directly above heavy hydrogen, and the chart continues thus to the most complete nucleus, curium 242. Empty spaces allow for reporting of new isotopes. In each square, in addition to the chemical symbol and atomic weight, other data such as proportion of isotope in the natural element, half-life if radioactive, and type of radiation emitted, are given. Altogether about 750 isotopes are included, of which 274 are stable forms which occur in nature and 47 are also natural but show radioactivity.

466 Molecular Spectroscopic Evidence of the Existence of Strontium Isotopes Sr^{88}, Sr^{87}, and Sr^{86}, by L. H. Ahrens. Physical Review 74, p. 74-77, July 1, 1948.

An analysis of certain heads of the sequence $v'-v'' = +1$ ($^2\Sigma \rightarrow {}^2\Sigma$) in SrF arc emission spectra, revealed three components at each of the first heads, the displacements of which show the presence of three strontium isotopes at masses 88, 87, and 86. A quantitative determination of the abundance ratio, 88/86 gave a value of 8.52, which is in reasonably good agreement (+ 2.0 per cent) with the abundance ratio of 8.38 determined mass spectrographically. The accuracy with which this ratio has been determined is considered to be within ± 4-6 per cent. Abundance ratios, 88/87 and 87/86 could be determined only approximately because of masking of the $Sr^{87}F$ component by the dominant $Sr^{88}F$ component. The spectra had been recorded using first order (dispersion, 0.848 A/ mm), but if second order were used, this masking would be reduced to an insignificant amount. For geological age requirements, mass-spectrographic measurement of strontium isotope abundance ratios is perferable because as little as 0.3 mg of strontium salt is required, whereas using molecular spectra, far larger amounts are required. As the maximum concentration of stronium in the most ancient rubidium-rich mineral does not exceed 0.02 per cent, inconveniently large quantities of mineral have to be employed to extract sufficient strontium for a molecular spectroscopic analysis.

ISOTOPES

467 A New Method of Measuring the Relative Abundance of Isotopes. The Isotope Distribution and Atomic Weight of Hafnium, by J. Mattauch and H. Ewald. Zeitschrift fur Physik 122, Nos. 5-8, p. 314-356, 1944. (In German).

A photometric method of measuring the relative isotope abundance from the blackening of a photographic plate is described. The plate was exposed to the mass-spectrum of the element under test (Hf) and other calibrating elements whose mass spectrum was accurately known from electrometric determination (Os, Kr, Xe, Zn and Hg). Results with Hf were:

Mass	174	176	177	178	179	180
% abundance	0.18	5.3	18.47	27.10	13.84	35.11

The method is quicker and more sensitive than the electrometric method.

468 The Physical Properties of Artificial Radioactive Isotopes with Special Reference to Their Medical Applications, by K. A. Evelyn. McGill Medical Journal 15, p. 337-370, 1946.

A review of the elementary physical principles governing the behavior and production of artificial radioactive isotopes, together with a discussion of the methods employed for the detection and measurement of the relevant radiations and the criteria adopted for the selection of the most suitable isotopes for medical applications is presented. The following tables are included: (1) a listing of the mass numbers of the naturally occuring isotopes of the elements; (2) the main physical characteristics of some of the more important artificial radioactive isotopes; (3) the characteristics of the isotopes of zinc, both stable and radioactive. Potential health hazards are briefly considered.

469 Pile Production of Radioactive Isotopes, by Waldo E. Cohn. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 42-51.

Once having decided upon the element and isotope, which define its chemical and nuclear properties, the major criteria involved in the matter of producing a radioisotope for biochemical use are those of total activity, specific activity, radiochemical purity, chemical state, and chemical form. These properties are dependent upon the two separate phases of radioisotope production, the nuclear reaction, which brings the isotope into existence, and the chemical manipulations by which it is converted to the desired chemical form and state.

The most prominent reaction undergone by nuclei introduced into the pile is the (n,γ) reaction, which yields nuclei isotopic with the parent and which are not carrier-free. In some cases such isotopes decay by beta-emission or orbital electron capture to active species which then exist as carrier-free radioelements (I^{131} from Te, Cs^{131} from Ba). Only a few direct transmutation reactions yield significant amounts of material, as in the production of P^{32}, S^{35}, C^{14} (all n,p reactions) and of A^{37} (n,α). The pile is limited in what it creates to (n,γ) reactions except for a few (n,p) and (n,α) reactions at the lower end of the periodic table. It is a fortunate circumstance that most of the radioisotopes of interest to biochemists can be created by transmutation reactions and are thus available in high specific activity. The quantity of a radioisotope produced in the pile is dependent upon the cross section of the reaction, the flux of neutrons available, the time of exposure relative to the half-life, and the competition of neighboring nuclei. Questions of physical and chemical stability during irradiation and of handling after irradiation are also involved in the choice of target, packaging, and length of exposure.

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ISOTOPES

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The isolation of a transmutation-born carrier-free radioelement differs in two ways from ordinary chemical separations: the discrepancy in relative masses of parent and product (usually on the order of 10^6: 1), requiring new methods if carrier-free material is to be isolated, and the presence of radiation, necessitating remote controlled processes. Four general methods have been used for such remote controlled radioisotope isolations: coprecipitation with nonisotopic carrier, elution by comolex formation from ion-exchangers, solvent extraction, and volatilization. The choice of method depends upon the matrix in which the radioelement is created, its chemical properties, and those of its parent and associated impurities, as well as upon the chemical state and form to which it is to be converted. The method of greatest general applicability to date is that of complexing elution from ion-exchangers, which is used to separate the major fission radioactivities from each other. Extraction and coprecipitation are used to isolate P^{32} from sulfur and volatilization is employed to recover I^{131} from Te and C^{14} from nitrates. The problems attending these and other separations and some special problems in pile radioisotope production such as high specific activity Fe^{59} and Ca^{45}, organically-bound C^{14} and S^{35}, and recoil reactions are discussed.

470 Production of Radioactive Isotopes by the Cyclotron and Other Methods, by John W. Irvine, Jr. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 52-59.

The two outstanding instruments for the production of radioactive isotopes are the chain-reacting pile and the cyclotron. The tremendous production capacity of the pile is unequaled and the versatility of the cyclotron makes possible the production of nearly every known radioactive isotope. Several of the chemical elements of interest to biochemists have radioactive isotopes with high specific activity available only through cyclotron bombardment. Among these are Na (3y), Mn, Fe (5y), Fe (44d), Co, Zn, As, Se, and Hg. They are all produced by the nuclear reactions (d,n), (d,2n), (d,α) or (n,p) which lead to radioactive products nonisotopic with the target. Thus carrier-free activities are produced. By proper choice of reactions isotopes such as Fe^{55} (5y) and Fe^{59} (44d) can be obtained radioisotopically pure, suitable for double tracer experiments involving a single chemical element. The reaction (d,p) is equivalent to an (n,γ) reaction. In general long-lived activities available through these two reactions are best produced by (n,γ) in the pile, while shorter-lived isotopes (less than a few days) can be prepared with as high or higher specific activity by (d,p). In a few specific cases such as preparation of At or Cm, only high energy alpha-bombardment can be used.

In cyclotron bombardments targets are placed on a probe in the vacuum chamber or in an outside chamber isolated by a thin aluminum window. The problem of dissipating 1 to 10 kilowatts of power limits the choice of target material and dicates bombardment site. Curves of the reaction probability versus deuteron energy show a characteristic shape for each type of reaction. In the range 1 to 14 Mev (d,p), (d,α) and (d,n) reactions have a maximum probability of occurring at intermediate energies which then decreases as competing nuclear reactions become more probable. The reactions (d,H^3) and (d,2n) show a steadily increasing probability of occurring up to 14 Mev, the maximum energy used. Although the reaction probabilities of some of the deuteron reactions go through a maximum, the thick target yields of all of the reaction show a steady increase with increasing energy. Increased range of the deuterons in the target compensates for decreasing cross sections.

Fast neutron reactions are initiated by the neutrons from Be^9 (d,n)B^{10}. By placing cobalt metal behind a beryllium target good yields of carrier-free Fe^{59} are obtained. Slow neutron irradiations can be made

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simultaneously by placing a sample in paraffin or water near the target and outside the cyclotron chamber. Moderate yields of several useful isotopes can be obtained with good specific activity if a Szilard-Chalmers reaction can be effected. With slow neutrons from a cyclotron, D. C. generator, or a Ra-Be source, this reaction furnishes isotopes of Cl, Br, I, As, and some of the platinum metals.

471 Preparation of Gas Samples for Mass Spectrometric Analysis of Isotope Abundance, by David B. Sprinson and David Rittenberg. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 82-93.

The only practical method available for determining the isotope abundances of nitrogen, carbon, oxygen, and sulfur involves use of the mass spectrometer. Because of the large mass difference between deuterium and protium other procedures as well can be used in the case of hydrogen of which the most advantageous is the falling drop method.

In the analysis of organic compounds for the isotope abundances of their constituent atoms it is necessary to obtain the element concerned in the form of suitable gas. The nitrogen of organic compounds is first converted to ammonia by a variety of methods depending on the structure of the compound and the problem being investigated. Thus ninhydrin will remove only the α-amino nitrogen of amino acids as ammonia, whereas the Kjeldahl procedure will almost always give total nitrogen. The ammonia formed is distilled into dilute acid, concentrated to a small volume, and transferred to one arm of a modified Thunberg tube. In the other arm is placed sodium hypobromite solution and the vessel evacuated in a high-vacuum line to less than 0.01 mm of mercury. After mixing, the solution is frozen in a dry ice bath, and the nitrogen liberated by oxidation of the ammonia is admitted into the mass spectrometer. When the combustion of an organic compound affords all of its carbon as carbon dioxide or, when for special purposes, the carboxyl carbon only of fatty acids, keto acids or amino acids is degraded to carbon dioxide, this gas is absorbed in saturated barium hydroxide solution. The barium carbonate is centrifuged, washed, and transferred to one arm of a modified Thunberg tube. The other arm is charged with dilute acid and carbon dioxide liberated in a manner analogous to that described for nitrogen.

Very often the amount of purified material available for analysis is too small to meet the requirements of the falling drop of other densimetric methods which are available for the determination of deuterium concentrations. Only about 5 mg are needed for a mass spectrographic analysis. The water obtained from the combustion of an organic compound is frozen with dry ice. After warming up, the water vapor is led over a bed of porous zinc at 400° and the resulting hydrogen is collected in a flask by means of a Toepler pump. The gas is now ready to be admitted into the mass spectrometer tube.

472 Radioisotopes. Journal of the American Pharmaceutical Association 8, p. 1-13, 1947.

In this editorial a general review of radioisotopes is presented. A description of the chain-reacting pile at Oak Ridge is given and the methods of chemical separation by remote control are reviewed. The use of radioisotopes in pharmacy as tracers and therapeutic agents is discussed. The effectiveness of radioactive iron in hyperthyroidism and radioactive phosphorus in polycythaemia vera are cited as the leading achievements of radioisotopes as therapeutics.

ISOTOPES

473 Technical Uses of Fission Products, by Leo Yaffe, Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 117-119, 1947.

The uses to which fission products can be put are considered. Excluding tracer materials, the most important use will probably be as a radium substitute in the treatment of tumors and cancers. Industrial uses may include radiography of casting, control procedures, and luminous paint. In the field of pure research important uses include studies of the chemical and physical properties of elements 43 and 81, and the use of several fission products to replace radium in the production of neutrons.

ISOTOPES SEPARATION

474 Chemical Methods of Isotope Separation, by Allen F. Reid. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 205-209.

The first successful separation of isotopes in sufficient quantities for chemical research was the electrolytic method for the separation of hydrogen isotopes. Except for this, the chemical exchange processes are favored for moderately large scale production of isotope concentrates because: (a) Power consumption is low; (b) Standard engineering practices may be used. The procedure used is comparable to distillation and consists of sending a gas upward through a column countercurrent to a liquid flowing downward over conventional type packing, with reflux at the concentrate end. It is necessary in most cases to cascade from a large tower cross section to progressively smaller sizes at higher concentrations of the desired isotope in order to decrease the time required to start production.

475 Fundamentals of Isotope Separation, by Karl Cohen. United States Naval Medical Bulletin. March-April 1948 Supplement, p. 6-16; Nucleonics 2, p. 3-9, June 1948. (See also MDDC-1138).

Isotope separation is usually accomplished by repeated application of an elementary process which by itself changes the concentrations only slightly. The importance of proper design of such cascades of separated elements became vital with the increasing scale and difficulty of isotope separation. The phenomenon of relaxation time makes proper cascading essential even for laboratory equipment. One may solve the cascade design problem for binary mixtures in a quite general way, and it will be valid for almost all separation processes. The solution is found by determining the smallest possible cascades for producing a given amount of product of given purity. This minimal cascade is called an "ideal cascade".

The size of an ideal cascade is the ratio of two functions: the value function, which represents the relative difficulty of obtaining material of any concentration from a fiducial concentration, and a separative power function. The separative power depends only on parameters of the particular process, such as the elementary separation factor and the flow per unit. The design of a separation unit thus reduces to maximizing the separative power. A general procedure for determining the separative power of any type element is outlined and illustrated by examples.

ISOTOPES SEPARATION

476 Separation of the Thallium Isotope. Part I, Mass-Spectroscopic Separation by W. Walcher. Zeitschrift für Physik 122, Nos. 5-8, p. 401-406, 1944. (In German).

A spectroscope described by the author was used to separate Tl^{203} and Tl^{205}. 25μg of 97.5% Tl^{205} and 15μg of 65% Tl^{203} was produced as a deposit on an Al foil target after 20 hours operation. The isotope yield was determined by target-current measurement with a rotatable disc with suitable aperture, calibrated by measurements with pure Bi^{209}.

477 Separation of the Thallium Isotopes. Part II. Spectral Investigation of Various Tl Mixtures, by H. Kopfermann, and W. Walcher. Zeitschrift für Physik 122, Nos. 5-8, p. 465-470, 1944. (In German).

The hyperfine structure of the spectrum of the two isotope mixtures (Tl^{203} and Tl^{205})was investigated by a photographic blackening process to test the results of a Tl isotope separation by Walcher. To give a sufficiently strong spectrum for an interferometer photograph with the small isotope quantities available, a special hollow cathode was used. The % purity as determined by this optical process is less than that by the electrometric process. This is due to the fact that the electrometric method gives instantaneous values, while the optical method yields the final values.

478 Thermal Diffusion and Other Physical Methods of Isotope Separation, by William W. Watson. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 28-41.

Although the separation factor per stage is smaller for thermal diffusion than for any other method of isotope separation, the simplicity of the Clusius and Dickel cascading process and the ease of operation recommend this method for certain gases. Of the isotopes of interest to biochemists, the heavy forms of C, N, and O may all be obtained with good yields because of the relatively high thermal diffusion constants of CH_4, N_2, and O_2. Experience with multistage concentric cylinder thermal diffusion columns which have produced 33 per cent C^{13} with methane, and with hot-wire columns which raised the O^{18} content of O_2 to 17 per cent are described. Partially separated isotopes of sulfur could undoubtedly be produced by thermal diffusion with H_2S or SO_2 using longer columns to counteract the effect of probably small thermal diffusion constants. Electromagnetic separation, using improved ion sources, should produce milligram quantities of very well separated isotopes of the biologically important metallic elements. The merits and weaknesses of the ultra-centrifuge separation method are outlined.

LABORATORIES

479 Microequipment and Microtechniques. Chemical and Engineering News 26, p. 1988-1989, July 5, 1948.

Nine photographs from the Argonne National Laboratory are shown which illustrate some of the equipment and techniques used in studying the chemistry of micro quantities of radioactive materials.

METALLURGY

480 Bonding of Metals by Adhesives, by J. S. Church and S. Feuer. AECD-2103), May 6, 1946, decl. January 13, 1947. 5p. Document for sale by AEC. (Disposition as required for use in research, development, or manufacturing work)

This report is concerned with various methods of bonding tuballoy to aluminum using various commercially available adhesives. Selected results for several bonding agents are tabulated.

Thermoplastic adhesives give strengths as high as 1200 psi at room temperature using etched tuballoy specimens. However, bonds show zero strength at 65°C due to increased flow at this temperature range. Thermosetting adhesives yielded bonds as high as 400 psi at 65°C. The weakness of the oxide layer was the limiting factor in both etched and unetched specimens (oxide formed on etched surface during curing cycle). Zinc plated specimens showed high strengths, but the bonding surface was not level and consequently only one-tenth of the total surface area was bonded for any given joint. Leveling of the zinc plated specimens was limited by the thinness of zinc plate.

481 Alloys for Use at High Temperature, by W. J. Robinson. Brooklyn, N. Y., Mapleton House, 1947. 79 p.

482 Correlation of Optical and Electron Microscopy, by J. S. Bryner. Metals Technology 15, No. 4, June 1948. 7p. (AIME Technical Publication 2364)

In the study of metallographic specimens in the electron microscope, there is need for a method of locating the same field in both the optical microscope and the electron microscope. A solution to the problem is provided by a specially designed specimen screen which contains an opening which can be absolutely identified and quickly located in the electron microscope. It is fastened to the silica film replica in such a position that the desired field in the specimen can be located at the identifiable opening in the specimen screen. The design of this specimen screen, a method for producing it, and a technique for fastening it to the silica film replica are described.

483 Extracting Beryllium or Beryllium Compounds from Beryllium Ores. British Patent No. 587, 483, International Alloys, Ltd., May 7, 1947.

484 Grains, Phases, and Interfaces; an Interpretation of Microstructure, by Cyril Stanley Smith. Metals Technology 15, No. 4, June 1948. 37p. (AIME Technical Publication 2387)

In this paper the simple concept is developed that many microstructures result from an attempted approach to equilibrium between phase and grain interfaces whose surface tensions geometrically balance each other at the points and along the lines where they meet. From this follows a number of principles which may prove to be of interest to the metallographer, and of practical use in explaining failures and in designing alloys for particular service. In general, the discussion is limited to structures obtained after full annealing. The simple principles do not apply to structures resulting from Widmanstatten mechanisms in precipitation, or to other structures not in local equilibrium and in which lattic coherency is a determining factor.

METALLURGY

485 Modern Metallurgy of Alloys, by R. H. Harrington. New York, John Wiley and Sons, 1948. 209 p.

486 Production of Beryllium, by Bengt R. F. Kjellgren. Journal of the Electrochemical Society 93, p. 122-128, 1948.

The production of beryllium by the reduction of BeF_2 with Mg is described.

487 A Refined Metallographic Technique for the Examination of Surface Contours and Surface Structure of Metals; Taper Sectioning, by A. J. W. Moore. Metallurgia 38, p. 71-74, June 1948.

A detailed account is given of taper-sectioning technique as a means of studying the surface features of metals. The method is not new but it has not been applied to any great extent, although in many respects its use permits closer study than the normal cross-section micro-examination method. It can be regarded as a more refined method for the examination of surface contours and structures of metal and has many useful applications.

488 Transient Nucleation, by David Turnbull. Metals Technology 15, No. 4, June 1948. 10 p. (AIME Technical Publication 2365)

The nucleation theory, developed by Volmer and Becker, when applied to transformations in condensed systems, leads to an incubation period in which no nuclei appear to form, and an increasing rate of nucleation with time thereafter. This incubation period arises from comparatively slow rates of diffusion in condensed systems and the consequent slow approach to steady state nucleation. An hypothesis of this type explains the acceleration of the nucleation rate with time observed in the decomposition of austenite to pearlite. Also it is shown that the increase in the nucleation rate during recrystallization observed in a number of investigations may be explained on the same basis when it is assumed that recrystallization occurs by a process of nucleation and growth.

The indices which appear in each number of Nuclear Science Abstracts will be cumulated for the semi-annual volume.

MINERALOGY

489 Locating Uranium with the Ultra-Violet Lamp, by J. de Ment. Mining Congress Journal, May 1946. 5 p.

This article is a brief review outlining a method for locating uranium containing minerals by their ability to fluoresce under ultra violet light, and estimating the uranium content of such minerals.

490 Possibility of Studying the Activity of Rocks by the Observation of α-particle Tracks in a Photographic Emulsion, by I. Curie. Journal de Physique et le Radium 7, p. 313-319, 1946.

A detailed discussion is presented on the possibility of determining the uranium and thorium content of ordinary rocks by observing α-particle tracks in a photographic film applied to the rocks' surface. Such determinations can be made only where radioactive equilibrium can be assumed. For the examination of normal granite, exposures of several months are needed. The same method can be used to study the distribution of radioactive elements within the rock.

491 Ultra-Violet Light in Mineral Prospecting, by J. de Ment. Mining Congress Journal, January 1945. 6 p.

The sources of ultra-violet light are briefly reviewed, and the use of such light in the detection of secondary uranium ores, petroleum, gems, scheelite, and Hg and Zn minerals are considered.

492 Uranium and Thorium Prospecting with the Geiger Counter, by J. de Ment. Mining Congress Journal, August 1947. 4 p.

Portable equipment for the radiometric determination of thorium and uranium in minerals is described.

NEUTRONS

493 Attempts to Detect the Emission of Secondary Charged Particles in the Fission of U^{235} by Slow Neutrons, by J. M. Cassels, J. Dainty, N. Feather, and L. L. Green. Proceedings of the Royal Society 191A, p. 428-441, 1947.

The experimental technique is described. The experiment indicates that secondary α-particles of ranges up to about 1 cm of air are emitted in the fission process to the extent of about 1 secondary α-particle in 30 fissions. It appears that the emission of light charged particles is not an important feature of the fission process.

NEUTRONS

494 Measurements of Neutron Intensities by Means of Boron-Lined Ionization Chamber, by H. Von Ubisch. Arkiv för Matematik, Astronomi och Fysik 35A, Paper 11, 1947. 9 p.

The design and operation of a neutron monitor of high senitivity for use with a cyclotron are described.

495 Neutron Cross Sections of the Elements, ed. by Clark Goodman. Cambridge, Mass., Addison-Wesley, 1948. 112 p.

496 Neutron Diffraction and Associated Studies, Part I, by E. O. Wollan and C. G. Shull. Nucleonics 3, p.8-21, July 1948. (Summary of various MDDCs)

A review of neutron diffraction techniques is presented and a comparison with similar X-ray diffraction techniques is made. The experimental and theoretical description of the interaction of neutrons with crystals, molecules, and nuclei is given and related to present and potential applications to metallurgy, crystal structure, and certain fundamental nuclear studies.

497 Range of Protons from $N^{14}(n,p)C^{14}$, by I. C. Cornog, W. Franzen, and W. E. Stephens. Physical Review 74, p. 1-4, July 1, 1948.

The mean range of protons emitted in the slow neutron disintegration of nitrogen has been measured in a cloud chamber to be 1.00 cm of air, in good agreement with other observers. It is suggested that this range and the energy (561 Kev) of the emitted protons as deduced from the n-H mass difference and the extrapolated end point of the C^{14} beta-ray spectrum be used to establish a reliable point on the proton range-energy curve. This point lies on Bethe's original 1937 range-energy curve, but disagrees with Bethe's curve revised to fit the ionization chamber range of artificially accelerated protons.

498 The Relative Yields of Some (n,2n) Processes, by P. Jensen. Zeitschrift für Physik 122, No. 5-8, p. 387-400, 1944. (In German).

The relative β-yields of the (n,2n) processes leading to the formation of C^{11}, N^{13}, O^{15}, F^{18}, Cu^{62}, Ag^{106} and Sb^{120} were measured and compared with the values found by Bothe and Gentner. Except for the lighter nuclei the results are similar. The relations between the (n,2n) capture cross-section and the primary neutron energy were determined experimentally, and they are smaller than those given in the theoretical formula by Weisskopf and Ewing. The (n,2n) cross-sections of heavy nuclei approach πr^2, the geometrical cross-section, with primary neutron energy of around 16 Mev.

NEUTRONS

499 Rule Regarding "Unoccupied" Neutron Numbers, by F. L. Breusch. Experientia 2a, p. 363-364, 1946.

A study of the neutron numbers 1-126 indicated that nine are not represented by a stable isotope. The examples given show that each of these non-existent neutron-numbers lies between those of the two isotopes of an element of odd atomic number.

Periodicals listed in this abstract journal are on file in the Library of Congress. The Union List of Serials may be consulted for the availability of these publications in other libraries. Members of the American Chemical Society may purchase microfilms or photoprints of some of the articles listed through this Society.

NUCLEAR PHYSICS

500 Annual Report, 1947. Washington, D. C., Bureau of Standards, 1948.

Pages 181-183 of the report describe work done by the Bureau of Standards in the field of nuclear physics.

501 Introduction to the Atomic Nucleus, by Robley Dunglison Evans. Cambridge, Mass., Massachusetts Institute of Technology, 1948. 131 p.

NUCLEAR PHYSICS - METHODS OF MEASURING

502 Beta-ray Measurements and Units, by M. Blau and J. E. Smith. Nucleonics 2, p. 67-74, June 1948.

The authors have developed an instrument, using a photomultiplier tube and standard radioactive source, for making beta-ray measurements in terms of a newly proposed unit, the roentgen equivalent physical. Comments are made on the disadvantages of presently used units.

503 Determination of Hard Radiation, Including Preparation of Samples, by William F. Bale. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 100-103.

Radioactive isotopes that emit penetrating beta- or gamma-radiation are usually detected and measured through the ability of these rays to render a gas electrically conducting by their ionizing effect. The ionization current thus produced may be measured through the use of a current-integrating instrument, such as the Lauritsen electroscope, the Lindenmann electrometer, or the vibrating reed electrometer. Alternatively, individual pulses of ionization may be counted, usually with some type of Geiger-Mueller counter. Any one of these instruments can be used satisfactorily in properly designed tracer studies. If economy is important, or if no one is available with the knowledge necessary to service electronic apparatus, an electrometer or electroscope is probably the instrument of choice. For maximum sensitivity, particularly if it is desirable to make many measurements of weak activities in a short period of time, an appropriate type of G-M counter is usually indicated. Two general types of G-M counting tubes suitable for beta-ray measurements are commercially available; a thin-walled, cylindrical type usually of glass or aluminum, and a bell-shaped tube with a thin mica window. The first type is less expensive; the bell counter is the most sensitive. Including backscatter, about 50 per cent of the beta-rays emitted from a thin-walled sample can be detected with such a tube. It is necessary for accurate radioactivity measurements that a reproducible geometry be used in presenting unknown samples as well as standards for measurement.

The elaborateness used in sample preparation may depend upon the accuracy desired in the result. Solid samples may often be prepared by filtration, by evaporation, or by ashing in standardized crucibles. The sample containers are then brought to a reproducible position at the counting tube. Metals may be often quantitatively electroplated on suitable planchets. Satisfactory accuracy and reproducibility can often be obtained by spreading samples uniformly, as judged by the eye, on suitable sample pans. One technique found useful is that of measuring samples in liquid form, usually as water solutions. A mica window, bell-type counter is satisfactory for this type of measurement.

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NUCLEAR PHYSICS - METHODS OF MEASURING

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Standard sample containers, usually of stainless steel, are prepared with a circular cavity of the diameter of the counting tube window, 1.25 to 1.75 inches in diameter and 0.125 inch deep. Two milliliters of unknown or standard are pipetted into the cup which is then brought to a reproducible position close to the tube window.

504 Determination of Soft Radiation, Including Preparation of Samples, by Arthur K. Solomon. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 104-114.

The radiation from radioactive carbon 14 and sulfur 35 is so soft (energy 145 to 160 kilo-electron volts) that special precautions are necessary in order to obtain a quantitative estimate of the amount of radiation given off. It is possible to measure radiation of this energy either in the gas phase, or in the solid phase, either inside or outside a counter or ionization chamber. A considerable controversy exists between the proponents of gas phase measurement (tritium radiation is so soft that it must be measured in the gas phase), and those of solid phase measurement, since there are advantages for each method. The choice of counter and the technique of measurement are largely dictated by economics.

The effects of self-absorption of soft radiation are very considerable; and here, too, the investigator is faced with a choice of technique that is dictated by economics. To carry out research with limited amounts of material at minimal radioactivity levels, it is necessary to perform accurate calibration experiments to take account of the density of the samples to be measured. At higher levels, it is preferable to use an infinite layer of material (a layer so thick that the radiation from the bottom surface is entirely absorbed before it reaches the counter). The techniques for making reproducible samples are described.

505 Use of the Photographic Plate in Nuclear Physics, by R. Chastel. Atomes 3, p. 191-194, June 1948. (In French).

Use of the Photographic plate enabled Becquerel to discover radioactivity. Visible traces in a photographic emulsion can be obtained from alpha particles as well as from other charged heavy particles, such as protons, deuterons and tritons. Photographic plates have permitted the experimental observation of the modes of fission of the uranium nucleus such as tripartition and quadripartition, and have been used in the observation of nuclear explosions produced by cosmic rays.

NUCLEAR PROPERTIES

506 Fine Structure of the He II Line $\lambda = 4686$ A, by H. Kopfermann and W. Paul. Nature 162, p. 33, July 3, 1948.

The authors have investigated the fine structure of the He II line $\lambda = 4686$ A ($n = 4 - n = 3$) with a Fabry - Perot interferometer and have found that the $3\ ^2S1/2-$ level lies 0.137 ± 0.015 cm^{-1} above the values given by the Dirac theory. Greater accuracy has not yet been possible because of the breadth of the lines.

NUCLEAR PROPERTIES

507 Nuclear Physics of the Deuteron and Other Two-Particle Phenomena, Part I, by M. E. Rose. Nucleonics 2, p. 57-66, June 1948.

The phenomenological approach to the problem of two-particle nuclear systems reviewed is shown to provide a direct means for deducing the fundamental nuclear force. Among the topics discussed are the two-particle problem, qualitative consideration of nuclear forces, ground state of the deuteron, and the scattering of neutrons by protons.

508 Nuclear Physics of the Deuteron and Other Two-Particle Phenomena, Part II, by M. E. Rose. Nucleonics 3, p. 57-64, July 1948.

The experimental evidence for the author's theory concerning the direct deduction of nuclear forces from models of two-particle nuclear systems is examined. The following topics are discussed: The scattering of neutrons by ortho and parahydrogen, proton-proton scattering, the interaction of the deuteron with electromagnetic radiation, and the non-central forces of the deuteron.

NUCLEAR THEORY

509 Observation of Mesons Produced by the 184-inch Cyclotron, by C. M. G. Lattes and E. Gardner. AECD-2087 (UCRL-124), June 4, 1948, decl. June 17, 1948. 2p. (For oral presentation at a meeting of the American Physical Society).

In the arrangement used for detecting mesons at the 184-inch Berkeley cyclotron the photographic plates are placed in a region where the flux of neutrons is high. Tracks arising from neutron-proton collisions and neutron-initiated stars make a "background" which slows down the study of the meson tracks. During the early exposures the ratio of background tracks to meson tracks varied from 10 to 10,000, and the reason for the variation was not understood. Some progress has been made toward an understanding of the factors which affect the background, and exposures have become more reproducible.

An important question to be answered is whether the light mesons all come from decays of heavy mesons, or whether they are produced in a primary process at the target. In order to investigate this question the ratio of light mesons to heavy ones for different energies of the initiating alpha particles is being measured. An example has been found of a positive meson decay in which the track of the secondary meson ends in the emulsion. The range of the secondary meson is 630 microns.

510 Disintegration of Mesotrons in B^{10}, by Norris Nereson. AECD-2098 (LADC-487), n.d., decl. June 7, 1948. 3p. Document for sale by AEC. (Disposition as required for use in research, development, or manufacturing work).

An experiment was carried out to determine if disintegration or capture processes for negative mesotrons showed any significant differences for boron-10 and boron-11. It is evident from the results obtained that no significant difference is present in the delayed or decay electron counting rate of the two boron absorbers. The evidence from these absorbers indicates that the interaction of negative mesotrons with nuclei depends on atomic number. The B^{10} data also provides additional evidence that the capture probability of negative mesotrons is very small in the case of boron.

NUCLEAR THEORY

511 Artificial Cosmic Radiation, by I. A. Getting. Technical Review 50, p. 435-440, June 1948.

There are two main aspects to the investigation of cosmic radiation. First is the study of the cosmos through the observation of the radiation, and second is the use of radiation in the investigation of the structure of matter itself. It is only through the use of cosmic rays, or recently developed particle accelerators, that sufficient energy is concentrated in a single particle to make a successful attack upon the atoms, and to learn the structure of its nucleus. Several different types of laboratory accelerators able to produce energy in the required ranges have been developed during the past 20 years. The behavior of elementary charged particles under the influence of electric and magnetic fields is reviewed, and the operation of the different types of particle accelerators is described. (TDD)

512 Artificial Production of Mesons, by L. LePrince-Ringuet. Atomes 3, p. 189-191, June 1948. (In French).

A discussion of mesons is given which includes the origin, characteristics and importance of these particles. The production of mesons artificially by means of the cyclotron is described.

513 Calculation of a Perturbing Central Field of Force from the Elastic Scattering Phase Shift, by Egil A. Hylleraas. Physical Review 74, p. 48-51, July 1, 1948.

It has been shown that the interaction potential between two particles can be uniquely determined from the supposed knowledge of the observed phase shifts for the whole energy range, but for only one particular angular momentum. Coulomb forces between charged particles, as well as all kinds of inelastic scattering, have so far not been considered.

514 Creation of Mesons by High-Energy Particles, by D. Ter Haar. Science 108, p. 57-58, July 16, 1948.

An estimate is made of the cross sections for the creation of mesons by nuclear particles, β- or γ-quanta using an electron synchrotron. This work is essentially an extension of recent work by McMillan and Teller. The author concludes that one may expect an optimum energy for the creation of mesons to exist somewhere in the neighborhood of 300 Mev ($2\mu c^2$).

515 On the Creation and Annihilation of Mesons by Interaction with Matter, by P. Urban. Acta Physica Austriaca 1, p. 55-73, 1947. (In German).

Using the perturbation theory with an interaction term involving the meson, photons and heavy particles, the cross-section for the creation of vector mesons is recalculated. Although the probability of production is considerably increased, the agreement with experimental values is not much better for the ratio of production of mesons to electron-pairs at sea level using the usual values for the mass and interaction constants.

NUCLEAR THEORY

516 On the Decay of Gamma Rays of the Meson, by M. Verde. Ricerca Scientifica e Reconstruzione 17, p. 2031-2037, December 1947.

517 On the Theory of Elementary Particles, by A. Pais. Amsterdam, North-Holland Publishing Co., 1947. 91 p.

518 Some Features of the Process of Fission of Heavy Nuclei, by J. Frenkel. Journal of Physics U.S.S.R. 10, p. 533-539, 1946.

The asymmetrical fission of heavy nuclei is a result of the dependence of the probability of the tunnel effect on the effective mass of the two fragments. The variation of activation energy with degree of asymmetry is investigated. The probability of the tunnel effect is calculated as a function of the excitation energy or temperature of the nucleus and compared with the probability of α-decay. The emission of secondary neutrons is treated as the partial evaporation of daughter nuclei due to high temperature and to the relatively low binding-energy. The fact that they fly off in a highly excited state is due to their marked deviation from the spherical shape.

NUCLEAR TRANSFORMATION

519 Nuclear Synthesis of Element 43 (Tc), by E. E. Motta and G. E. Boyd. AECD-2097, June 14, 1948, decl. June 29, 1948. 8 p. (For oral presentation before a symposium on New Elements sponsored by the American Chemical Society held in Syracuse, N. Y., June 30, 1948).

An abstract of this document has previously been issued as AECD-1989 and listed in Abstracts of Declassified Documents.

520 Theory of the Lithium Two-Alpha-Reactions. Part 1, Angular Distribution of Li^7 (p,α)α, by D. R. Ingles. Physical Review 74, p. 21-33, July 1, 1948.

The reactions $Li^7(p,\alpha)\alpha$ and $Li^6(d,\alpha)\alpha$ have a special interest because the Bose statistics and consequent even parity of the final pair of alphas simplifies the analysis. It is assumed on reasonable grounds that Li^7 has odd parity and Li^6 even. This means that only p, f. . . protons entering Li^7 are relevant to this reaction, and only entering s, d. . . deuterons of Li^6. An expression for the energy variation of the angular distribution in the Li^7 reaction is derived from the dispersion formula, with the specific assumption that only two levels of the compounds nucleus, having angular momentum 0 and 2, are important in the range of energies employed in the experiments. (An alternative assumption is investigated but is more involved and it is considered less plausible.) The angular factor is $1 + A(E) \cos^4\theta + B(E) \cos^4\theta$. A formula for A(E) as far as it results from entering p waves has been derived previously by Critchfield and Teller, but it may not be adjusted to fit the data in the energy range up to 3 Mev even within the rather large experimental uncertainty. The effect of entering f waves is also included in the present analysis, and this contribution is not only essential to the existence of B(E) but also makes it possible to obtain agreement with the recent measurements of A(E).

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NUCLEAR TRANSFORMATION

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Certain matrix elements are treated as arbitrary parameters in obtaining this fit. In addition to the low-energy node apparent in the early data, a second node of A(E) is required at higher energy. The formula derived for B(E) contains the same resonance denominator as does A(E) and is compatible with the present experimental results. The contrasting facts, first that the easy entrance of s waves makes the $Li^6(d,\alpha)\alpha$ reaction symmetric at very low energies and second that the p waves responsible for the Li^7 reaction at low energies may introduce asymmetry, are associated in a simple way with the qualitative experimental observation that both A(E) and B(E) rise more quickly in the Li^7 reaction than in the Li^6 reaction as the bombarding energy is increased from zero. Presentation of a detailed formulation of the Li^6 reaction is deferred until a later paper.

NUCLEONICS

521 Physical Science and Human Values, a Symposium by 1946 Princeton Bicentennial Conference on the Future of Nuclear Science. Princeton, N. J., Princeton University Press, 1947. 181 p.

PHYSICS, GENERAL

522 A Study of the Arc Plasma, by D. Bohm, E. H. S. Burhop, H. S. W. Massey, and R. M. Williams. AECD-2094 (BP-39), n.d., decl. July 9, 1948. 217 p. (To be included in the NNES.)

The number of factors which influence the performance of an arc-type ion source is very great. In order, therefore, to determine which factors are important, and to understand the functioning of such a source in practice, it is desirable to experiment under conditions so simplified that the maximum number of factors are controllable and reproducible and the amount of basic information available is as great as possible. An extensive series of observations was therefore carried out on arcs which were run with argon instead of uranium compounds and in the absence of high voltage. The use of argon is a great gain in simplicity both experimentally and for the interpretation of results. Thus it is possible to measure and control the pressure of the gas in the arc chamber at any time, and there is no problem of controlled evaporation or of cleaning after a run; the filamentary cathode runs hot instead of activated, behaving much more regularly, and there is much less sparking. There is also no difficulty in using probes in the plasma, whereas in uranium compounds the deposition of uranium metal would lead to variable results. The amount of basic information concerning the behavior of electrons and ions in argon is very considerable and the interpretation of results is further simplified by the presence of at most two positive ion species (A^+ and A^{++}) and no negative ions.

With this arrangement a systematic study was made of the variation of ion density throughout an arc plasma under a wide range of conditions of arc voltage and current, magnetic field and argon pressure. Comparison was also made between the behavior of the plasma in two arc chambers, one with sixteen times the cross section of the other. Besides ion density, the distribution of secondary current between the ends and sides of the chamber, the space potential throughout the plasma, the electron temperature, and the quality, amplitude and distribution of the current hash, were also studied in a systematic manner. A further series of studies was carried out on the effect on these various quantities of applying small potentials to the arc block and to wires in the arc. The next step in

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complexity is to replace argon by an electro-negative gas to observe the effect of negative ions. A number of observations, though less extensive than for argon, were therefore carried out using chlorine which has the advantage of being close to argon in mass.

A description of the results of these observations and a summary of their significance and interpretation is the object of this report. Although a great amount of material is included, the number of variables is so great that gaps inevitably remain in the knowledge of this phenomena. Nevertheless, a number of results have been obtained which have been useful in obtaining an overall picture of the properties of an arc.

523 Franklin's Discovery of the Electron, by Robert A. Millikan. American Journal of Physics 16, p. 319, May 1948.

The author quotes from a letter written by Franklin which he believes clearly establishes the right of Franklin to be considered as the discoverer of the electron.

524 Historical Survey of the Theories with Regard to the Nature of Radiation, by G. M. Reviglio. Radiologia (Rome) 1, p. 157-167, 1946.

An historical survey is presented of the various theories of radiation phenomena from Decartes and Newton up to the present time. It is pointed out that hypotheses advanced by de Broglie, Schrodinger, Dirac and Heisenberg with regard to wave mechanics and quanta have done away with the contradiction between the wave and corpuscular theories.

525 How's Your Atomic Vocabulary, by Thornjin R. Hogness, Mining and Metallurgy 29, p. 290, May 1948.

Simple explanations of a few atomic terms are provided by Thornjin R. Hogness of the University of Chicago.

526 Interaction of Isotopic Radiation with Matter, Part II, by Rex G. Fluharty. Nucleonics 2, p. 46-56, July 1948.

The three ways in which photons interact with matter are: photoelectric effect, Compton effect, and pair production. Means for calculating absorption coefficients for the different types of interactions are given.

PHYSICS, GENERAL

527 On the Ionization Potentials of the K and L Electrons, by Anthony Felix Richter. Philosophical Magazine 39, p. 303-313, April 1948.

The ionization potentials, J, of the K and L isoelectronic rows (mono-to deka-iso-rows) form arithmetical progressions of the second degree. The equations based upon this recognition make it possible to figure out the J values of K and L electrons of any element Z in a given iso-row. There are three constants in the equations: the row constant A_i, the quantum constant B_i and the correction constant D_i, the theoretical significance of which is explained by the author. Deductions made are as follows: The differences between J of two corresponding members in two isoelectronic rows, the so-called inter-row potentials form arithmetical progressions; these are the progressions of the first degree when the quantum constants of the two compared equations are identical, or they are of the second degree when the quantum constants are different. By means of the inter-row potentials and of the inter-constants it is possible to convert any equation of the higher iso-row to the fundamental equation of the mono-iso-row.

528 Radiation from Electrons Accelerated in a Synchrotron, by F. R. Elder, R. V. Langmuir and H. C. Pollock. Physical Review 74, p. 52-56, July 1, 1948.

High energy electrons subjected to large radial accelerations radiate considerable energy in the optical spectrum. The distribution of energy in the light from a synchrotron beam has been measured and compared with theory at several electron energies up to 80 Mev. The results indicate reasonable agreement with theory. Measurement of total light output allowed an estimate of electron current in the beam. High speed photography of the light permitted observation of the size and motion of the beam within the accelerator tube.

529 The Theory of the 'Luminescent' Electron, by D. Ivanenko and A. Sokolov. Doklady Akademii Nauk SSSR, 59, p. 1551, March 1948.

530 Repulsive Forces in Relation to Bond Energies, Distances and Other Properties, by Kenneth S. Pitzer. Journal of the American Chemical Society 70, p. 2140-2145, June 1948.

A revised table of bond energies is calculated from recent sources. The concept is introduced of a balance in a chemical bond between attractive and repulsive forces both of electronic nature. In first row elements the repulsive effects for single bonds arise principally in the valence shell whereas for heavier atoms the inner shells play a predominant role. The ideas are shown to account for several peculiarities in bonding behavior.

PARTICLE ACCELERATORS

531 Theory of Synchrotrons, by R. Wideroe. Bulletin des Schweizerischen Elektrotechnischen Vereins 39, p. 319-328, May 15, 1948. (In German).

After giving an account of the essential characteristics of the best known instruments of acceleration used in nuclear research, the cyclotron, betatron and synchrotron, the author establishes the formulae of movement of the ions and electrons accelerated in the synchrotron. He deals with uniform movement without perturbations, as well as phase oscillations of particles and the effect of an irregular acceleration produced by successive levels. He studies transitory states between two synchronisms (gigator), then presents a numerical example.

532 Waves and Electrons Traveling Together; A Comparison between Traveling Wave Tubes and Linear Accelerators, by L. Brillouin. Physical Review 74, p. 90-92, July 1, 1948.

A general theory is needed that would include both extreme cases of traveling wave amplifiers and linear accelerators without introducing any restriction on the magnitudes of either fields of space charge. A special case is given as an example and represents a curious sort of electromagnetic shock waves.

PUMPS

533 A. E. C. Gets Pump Patent. Chemistry 21, p. 40-41, June 1948.

Patent 2,437,897, concerned with a multiple-stage diffusion pump, has been assigned to the Atomic Energy Commission. The apparatus actually operates more like a fractionating still than like a conventional pump. A multichambered evaporating vessel at the bottom sends its least volatile vapors up a low-pressure chimney at the center, its higher-pressure vapors, up an annular chimney on the outside. Vents from the low-pressure chimney are so arranged that the more volatile condensates are sent down to the outer chambers of the evaporating vessel. Thus segregation of the fractions increases progressively.

QUANTUM MECHANICS

534 A Note on M. de Broglie's Theory of the Photon, by Marjorie Williamson. Philosophical Magazine 39, p. 314-324, April 1948.

De Broglie, in developing his theory of the photon, endeavors to establish an analogy between polarization and spin by employing the theory of Dirac which is so satisfactory with respect to the spin of the electron. Since interaction with matter always results in the disappearance of the photon the theory must include the possibility of annihilation, and this leads de Broglie to suggest that the photon may be composed of two complementary particles: "demi-photons" corresponding to the positron, and the electron of the Dirac theory. By giving each half photon a spin of $1/2$ $(h/2\pi)$ as for an electron, the integral spin of the complete photon is obtained.

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QUANTUM MECHANICS

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The author presents the theory in a simpler manner, considering the photon as a single particle of mass μ_0 which may be vanishingly small. Its behavior can be described by the Dirac equation if the wave function ψ is regarded as a complete matrix with 16 components, and not merely 4 as in the case of the charged particle. Using this concept several photon equations are calculated, expressions for the electromagnetic field of the photon set up, and equations for the spin and magnetic moments of the photon derived.

535 The Second Order Wave Equation for a Dirac-Pauli Particle, by L. A. Radicati. Nuovo Cimento 5, p. 173-180, June 1, 1948. (In Italian).

The second order wave equation for the Dirac-Pauli particle in case of stationary motions is studied because of the great importance assumed by it in the problem of the magnetic moment of the deuteron. It is shown that the Pauli term in the first order equation may be accounted for by adding to the operator representing the mechanical and electric moment two terms which can be referred to as magnetic and electric dipole moment. These terms are: $\lambda/c\beta\sigma_0 H$ and $i\lambda/c\beta E$. The Dirac-Pauli equation then takes the form:

$$\left\{\alpha + \left[P - \frac{\lambda}{c}(\beta\sigma_0 H + i\beta E)\right] + \frac{W + E_0 + e\phi + \beta E_0}{c}\right\}\mu = 0$$

Starting from this the second order equation can be shown to assume a form which permits an interpretation of the total energy of the particle, as arising from the interaction of the various moments (i.e. mechanical, electric, and dipole) with each other.

RADIATION SICKNESS

536 Doctors Get Guide for Use in Atomic Attack. Science News Letter 54, p. 8, July 3, 1948.

Treatment of proven value for atomic casualties consists of normal nursing care; adequate diet high in protein and calories, low in residue, or bulk, and with added vitamins; fluids injected into the veins; whole blood; penicillin, sulfa drugs and the like; sedatives to help the victims sleep. Treatment that may be of value consists of vitamins C and B_6 one of the adrenal gland hormones, and two chemicals which may help control bleeding. These are rutin and toluidine blue.

537 What Every Medical Officer Should Know about the Atomic Bombs. Part IV. Evaluation of the Five Atomic Explosions. Bulletin of the U. S. Army Medical Department 8, p. 350, May 1948.

Lethal effects will be produced by air-burst atomic bombs over an area of 2 square miles and measurable effect over an area of 7 square miles as a result of the gamma radiation emitted at the time of detonation. There is little importance in the residual radioactivity except in the area close to the center of a low-altitude explosion. In an underwater detonation, radioactive fission products and unfissioned material will be spread by the cloud and base surge over a large area. The gamma radiation

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RADIATION SICKNESS

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from these materials will be lethal to exposed personnel more than two miles downwind, and serious contamination will result at much greater distances. A serious hazard will be provided by this detonation for an indefinite period. At the time of the detonation prompt evasive action will permit the reduction of casualties. The pathologic effects of radiation are presented by outlining the early and late changes in tissue cells, organ systems, total body irradiation, and internal radiation by radioactive materials introduced into the body either accidentally or therapeutically. The sensitivity of various body tissues has been established and has been expressed largely as the relation of one tissue to another.

RADIOACTIVITY

538 Energy Quanta Emitted in Disintegration of Ground State of Ba^{133}, by Fu-Chun Yu and D. J. Kurbativ. Physical Review 74, p. 34-37, July 1, 1948.

The ground state of radioactive Ba^{133} was correlated with the metastable state of Ba^{133*}. It was found that after K-electron capture occurs, there are two excited states in Cs^{133*} corresponding to observed two photons of 320 ± 10 Kev and 85 ± 5 Kev. Both gamma-rays are converted. The conversion ratios for these two photons are $N_e/N\gamma \approx 0.02$ and $\approx$ 0.34, respectively. The change in angular momenta of the excited states of Cs^{133*} due to emission of 320-Kev and 85-Kev photons is calculated to be L = 2 and L = 1. Attempts to observe a third gamma-ray of ~ 405 Kev did not yield positive results. The calculated intensity of the 405-Kev photon, if it is emitted, is estimated as equal to 0.001 of the intensity of the 320-Kev photon.

539 Internal Conversion Electrons From Sm^{153}-47 Hour, by R. D. Hill. Physical Review 74, p. 78-79, July 1, 1948.

The internal conversion electron spectrum of 47-hour beta-radioactive Sm^{153} has been investigated with a beta-ray spectrograph. Fourteen lines have been measured in the energy region up to 300 Kev, nine of which can be attributed to internal conversions of two gamma-rays of 103 and 69.5 Kev energy. Other lines are due to Auger electrons from Eu^{153}, and two weak lines are not assigned.

540 Loss of Radioactivity From Barium Carbonate Samples, by P. E. Yankwich. Science 107, p. 681-683, June 25, 1948. (See also AECD - 1831)

The exchange loss of radioactivity from solid samples of barium carbonate through the agency of carbonic acid and its ions has been investigated under a variety of conditions. It is concluded that the losses observed are greatly dependent upon the method of sample preparation, in particular the nature of any heat treatment which the sample materials undergo.

It is certain that barium carbonate-carbon dioxide exchange can occur rapidly only when the soild is in contact with a medium in which both carbon dioxide and barium carbonate are appreciably soluble; this is demonstrated by the failure to observe exchange when alcoholic solutions are used. There is also a surface effect involved, for under the same conditions precipitates which had not been warmed exchanged much more rapidly than those which had been subjected to heating; such effects are well

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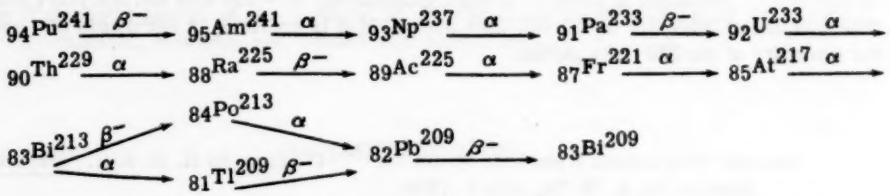
known and are responsible for the solubility denaturation of such precipitates as aluminum and ferric hydroxides.

541 Natural and Artificial Radioactivity, an Introduction to Atomic Physics, by E. Heller. Schweizerische Medizinische Wochenschrift 77, p. 542-546, 1947.

A historical summary is presented of the development of atomic physics during the past 50 years. The summary begins with the discovery of X-rays and radioactivity and goes up to the practical accomplishment of the production of energy by fission of atomic nuclei.

542 The Neptunium (4n + 1) Radioactive Family, by Glenn T. Seaborg. Chemical and Engineering News 26, p. 1902-1906, June 26, 1948. (See also MDDC - 1806.)

The experimental work of the last six or seven years has led to the production and the measurement of the radioactive porperties of all the members of the heretofore missing 4n + 1 mass type radioactive family. The main line of decay for this series, for which the name "neptunium family" is suggested by analogy with the names for the other natural radioactive families, is as follows:



The radioactive properties of Th^{233}, U^{237}, Cm^{241}, Pu^{237}, and Pa^{229}, nuclei of the 4n + 1 mass type, but known as "collateral" members because they are not in the direct line of decay of this family, are also known. 52 references.

543 Radioactive Europium, Gadolinium, and Terbium, by N. L. Krisberg, M. L. Pool, and C. T. Hibdon. Physical Review 74, p. 44-47, July 1, 1948.

An activity with a half-life of 18.0 ± 0.2 hours and a weaker one of 5.5 ± 0.2 days have been produced by neutron bombardment of gadolinium, resulting in a saturation intensity ratio of 25. A deuteron bombardment of gadolinium gave a ratio of 3 and produced 72-day Tb^{160} with a saturation intensity equal to that of the 5.5 day. The 18.0-hour activity decays by the emission of negative β-particles of 0.85 Mev and a γ-ray of 0.3 Mev. The 5.5-day activity decays by the emission of negative β-particles of 0.5 Mev and γ-rays of 1.28 Mev. Neither the 18.0-hour nor the 5.5-day substance is produced by fast neutron bombardment of Tb, but there is some evidence that both are produced by fast neutron bombardment of dysprosium. In accordance with the above data both the 18.0 hour and the 5.5-day activities are assigned mass 161. An activity with a minimum half-life of 20 years and one with a minimum half-life of 75 days have been produced by a deuteron bombardment of europium. The decay of the 20-year activity is by the emission of β-particles of 1.4 Mev and a γ-ray. The 75-day activity is probably attributable to Gd^{153} and the 20-year activity to Eu^{154}.

RADIOACTIVITY

544 Radioactive Isotopes of Ru and Tc, by D. T. Eggen and M. L. Pool. Physical Review 74, p. 57-62, July 1, 1948.

A new isotope of Ru and one of Tc were found when Mo was bombarded with alpha particles. The Ru activity decayed with a half-life of 1.65 ± 0.05 hours. Positrons, X rays, and gamma rays were emitted with energies of 1.1 Mev, 0.7 A, and 0.95 Mev, respectively. The Ru activity also was produced by fast neutron bombardment of Ru. The Tc activity decayed with a half-life of 20.0 ± 0.5 hours and emitted X rays of 0.7 A and gamma rays of 0.78 Mev. The Tc activity also was made by proton bombardment of Mo. Electromagnetically separated Mo^{92} of 92 percent abundance was bombarded with alpha-particles producing the 1.65-hour and 20-hour activities. Electromagnetically separated Mo^{94} of 75 percent abundance under the alpha-particle bombardment made a 2.8-day activity. Thus the 1.65-hour, 20-hour, and 2.8-day activities can be assigned to Ru^{95}, Tc^{95}, and Ru^{97}, respectively.

545 Synopsis of Basic Ideas in the Theory of Radioactivity and the Detection of Radiation, by Richard D. Present. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 94-99.

Topics discussed are: 1. Criteria of stability of atomic nuclei; emission of electrons, positrons and gamma rays; K electron capture; nuclear isomerism; internal conversion. 2. The exponential decay law; the statistical character of beta-decay; Fermi's theory. 3. The Szilard-Chalmers separation method. 4. The absorption of fast electrons in traversing matter. 5. Instruments for detection of ionizing radiation. 6. Self-quenching Geiger-Mueller counters. 4 references.

RADIOCHEMISTRY

546 Change of Hydrolysis of Carbon Tetrachloride by X-rays on Addition of Alcohol, by W. Minder, H. Knuchel and P. Gurtner. Experientia 4, p. 219-220, 1048. (In German).

Hydrolysis of carbon tetrachloride in aqueous solutions by X-rays is changed quantitatively and qualitatively when alcohol is added to the solutions. This change conforms with a new theory of the actions of radiations published recently by one of the authors (Schweizerische Medizinische Wochenschrift 77, p. 194, 1947).

547 Chemical Effects of Nuclear Transformations by R. R. Edwards and T. H. Davis, Nucleonics 2, p. 44-56, June 1948.

The extensive chemical changes induced by nuclear processes are described, with a review of the contribution which their study has made to the understanding of nuclear and molecular phenomena. This new field of chemistry is defined and logically developed from basic consideration.

RADIOCHEMISTRY

548 Symposium on Radiation Chemistry and Photochemistry, by S. C. Lind and others. South Bend, Ind., University of Notre Dame, 1947. 611 p.

RADIOGRAPHY

549 Radioautography in Biological Research, by Aubrey Gorbman. Nucleonics 2, p. 30-42, June 1948.

This survey of the biological fields in which radioautography has proved useful illustrates the extensive range of applications the radiographic technique has for precise determination of the spatial distribution of radioactivity in both plant and animal tissues; 45 references.

550 The Radioautographic Technique, by Dorothy J. Axelrod and Joseph G. Hamilton. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 122-141.

Radioautography is a technique by which radioactivity in a material may be precisely located. This method depends upon the photographic effect of radioactivity, and consists of placing photographic film or emulsion in contact with material containing radioactivity. The areas of blackening on the film correspond to the site of localization of the radioelement.

There are four methods of making autographs: 1. The whole tissue, or gross autograph in which the whole piece of tissue or a very thick tissue section is placed in contact with film. 2. The histologic section in contact with a photographic film or plate. 3. The histologic section mounted on a photographic film or plate. 4. The histologic section covered with a photographic emulsion.

RADIOTHERAPY

551 Atomic Energy Commission to Support Cancer Research, Journal of the American Medical Association 136, p. 836, March 20, 1948.

The Atomic Energy Commission is expanding its assistance to the nationwide work on cancer research by a program which involves radioactive materials, new facilities and financial aid. A general outline of the purpose of the program is given and facilities where cancer research is being supported by the AEC are listed.

552 The Functional Capacity of Thyroid Tumors as Judged by Radioactive Iodine Uptake, by J. W. McArthur and O. Cope. Journal of Clinical Investigation 25, p. 929, 1946.

Radioactive iodine was administered to patients with thyroid tumors in tracer dosage and the radioactivity of the tumor was compared with that of the adjacent tissue. The poorly differentiated tumors collected less iodine than the adjacent tissue; the differentiated tumors collected more, and in two instances, all of the iodine. Six malignant tumors collected from none to a quarter of the radioactive iodine taken up by adjacent tissue. In three instances, metastases collected detectable amounts of iodine.

RADIOTHERAPY

553 The Machinery of the Body, by Anton J. Carlson and Victor Johnson. Chicago, University of Chicago Press, 1948. 220 p.

This book has a section on radioactive elements in medicine.

554 Medical Aspects of Atomic Energy, by F. H. Krusen. American Journal of Pharmacy 119, p. 24-34, 1947.

The application of radioactive isotopes to the treatment of neoplastic and thyroid diseases are considered. The deleterious effects of the radiations on man are mentioned briefly.

555 Neutron Therapy and Specific Ionization, by Robert S. Stone. American Journal of Roentgenology and Radium Therapy 59, p. 771-785, June 1948.

The physical measurement of neutron radiations in air in units that can be translated to tissue doses comparable to tissue roentgens has been difficult. The n unit of exposure is physically equivalent to about 2.5 roentgens as judged by the amount of energy absorbed from a beam by tissue. In other words, 1 n = 2.5 rep (roentgen equivalent physical). Gross and microscopic studies of mammalian tissues have shown little or no qualitative difference in the reactions produced by neutron and roentgen ray radiations. The relative biological effectiveness of various radiations, as judged by the amount of energy absorbed from the beam in producing a given reaction, varied greatly from one test object to another and from one reaction to another even in the same tissue. In general, the relative biological effectiveness of radiations on mammalian tissue was greater the higher the specific ionization. Neutrons were more effective than roentgen rays per unit of energy absorbed by tissue. It was hoped, therefore, that they might be more effective in the treatment of human cancer.

The relative biological effectiveness of neutrons compared to roentgen rays is greater for late than it is for early effects. Whereas, 1 rep of neutrons might equal 2.5 r of roentgen rays for a threshold skin reaction, it might equal 4 r for late skin effects and even 15 r for the chronic effect of shortening the life span by repeated daily doses. Biological work showed that for some effects of radiations, the distribution of ion pairs "in time" played a part similar to that of the distribution in space. The rate of administration was not sufficiently weighted in the treatment of patients.

From a study of the patients treated with neutrons it is clear that cancer cells can be killed and patients "cured" of their cancer, but the difference between the dose required to kill cancer and that to acutely damage normal tissue is very small. The difference is even less when reactions occurring several years after treatment are taken into account. Eighteen patients have been kept alive, but none of them are free from distressing late effects. Anyone contemplating the use on patients of new radiations such as multimillion volt protons, beta rays and roentgen rays should study the relative biological effectiveness of them by late reactions as well as by acute early ones.

556 Radioactive Iodine Treatment of Graves' Disease; A Progress Report, by S. Hertz and A. Roberts. American Society for Clinical Investigation 25, p. 927, 1946.

Thirty-one cases of Graves' disease were treated in the Massachusetts General Hospital from May 1943 to January 1945 by internal beta-irradiation of the hyperplastic thyroid. The therapy is described as

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safe, highly effective, and relatively inexpensive. It is suggested that this method may displace surgery in the near future.

557 The Radioactive Isotopes; Their Application in Medicine, by L. Mallet. Semaine des Hopitaux de Paris 23, p. 548-553, 1947.

Radioactive isotopes are discussed from the standpoint of productions, methods of using them in biological and medical research, and their therapeutic applications. Their use as tracers for identification in tissues by Geiger counters and with different kinds of radiophotographic technique are reviewed. The therapeutic uses of radiophosphorus in polycythaemia and leukemia and of radioiodine in hyperthyroidism are mentioned. Two cases of polycythemia, showing good clinical and hematological response to 1 and 1.5 millicuries, respectively, of radiophosphorus are presented.

558 Radioactive Phosphorus, P^{32}; A Six-Year Clinical Evaluation of Internal Radiation Therapy, by C. A. Doan, B. K. Wiseman, C. S. Wright, J. H. Geyer, W. Myers, and J. W. Myers. Journal of Laboratory and Clinical Medicine 32, p. 943-969, August 1947.

100 patients were treated with radioactive phosphorus, P^{32}, at Ohio State University and the results of this study are analyzed. The series included 20 cases of polycythemia, 29 of lymphatic leukemia (18 acute, 11 chronic), 14 of myelogenous leukemia (1 acute, 13 chronic), 10 of monocytic leukemia (9 acute 1 chronic), 16 of Hodgkin's disease, 5 of metastatic carcinoma and sarcoma, 4 of multiple myeloma, and 1 each of mycosis fungoides and exfoliative dermatitis. Investigations included complete blood counts, erythrocyte sedimentation rate, packed cell volume, basal metabolic rate, and, in cases of polycythemia, blood volume determinations. Repeated bone-marrow examinations by sternal puncture with supravital technique were also made. Radioactive phosphorus obtained by cyclotron bombardment of red phosphorus and converted into dibasic sodiumphosphate was used at first. Subsequently radioactive phosphorus obtained from the uranium piles in Oak Ridge and supplied as KH_2PO_4 was used and administered orally. A detailed report is given of each case treated.

559 Some Uses of Radioactive Isotopes in Medicine, by Howard L. Alt and John A. D. Cooper. Industrial Medicine 16, p. 533-585, December 1947.

560 Therapeutic Applications of the Radioactive Isotopes, by C. B. Peirce. McGill Medical Journal 15, p. 371-387, 1946.

This article is a review of the therapeutic uses of P^{32}, Na^{24}, Sr^{89}, Ca^{45}, radioactive iron and radioactive iodine, together with a brief survey of possible applications of S^{35}, Br^{82}, C^{14}, or P^{32} as an external source of beta radiation, and radiocobalt (Co^{60}) as an external gamma ray source. The therapeutic applications of high voltage X rays and fast and slow neutrons are also mentioned.

RADIOTHERAPY

561 Therapeutic Uses of Thorium, by H. Corsi. Lancet 1943, p. 346-348.

Throium X (Ra^{224}) is a short-lived radioactive metal of atomic weight 224; 99% of its emanation consists of alpha rays. It can be applied to the skin either as a suspension in amyl acetate or dissolved in n-propyl alcohol. The use of the metal in the treatment of certain groups of skin diseases is described and its is concluded that thorium X is a valuable therapeutic agent in psoriasis and alopecia areata, and sometimes superior to X rays for amelioration of subacute and chromic dermatitis, particularly of the lichenified type. Encouraging results are also reported in the treatment of onychomycosis, sycosis and naevi of the purely capillar type.

Atomic Energy Commission declassified documents listed as available for sale may be obtained from:

Document Sales Agency
P. O. Box 62
Oak Ridge, Tennessee

RADON

562 Mixed Adsorption of Radon and Argon on Silica Gel, by Benjamin P. Burtt and J. D. Kurbatov. Journal of the American Chemical Society 70, p. 2278-2282, June 1948.

An apparatus is described suitable for studying binary mixed gas adsorption in which one component is radioactive or contains radioactive atoms as a tracer. The apparatus is also suitable for certain mixed adsorption studies by conventional means. Simple adsorption isotherms were obtained for air, argon and carbon dioxide on silica gel at 25°. Adsorption isotherms for radon in air, in argon and in carbon dioxide on silica gel at 25° were studied. The isotherm in air follows Henry's law and substantiates the Langmuir theory of mixed adsorption as applied to low concentrations. The adsorption of radon is slightly suppressed in carbon dioxide. The studies with radon in argon show that the adsorption of radon is enhanced in the presence of argon even though a very small fraction of the total surface of silica gel is covered by radon. The heat of adsorption of radon in air and in argon was estimated from the data obtained to be of the order of magnitude of 9,000 calories per mole. Methods are described for the use of radioactive argon to follow the adsorption of argon in mixtures with carbon dioxide and with air.

RARE EARTHS

563 The Absorption of Light in Solutions of the Rare Earth Salts, by J. Hoogschagen and C. J. Gorter. Physica 14, p. 197-206, May 1948.

The absorption spectra of aqueous solutions of europium, terbium and erbium salts are reported. A list of the oscillator strengths of all rare earths is given and the results are shown in a diagram.

SCIENTIFIC RESEARCH

564 Centro di Studio Pez la Fisca Nucleare - Progress Report for 1946, by E. Amaldi. Ricerca Scientifica e Ricostruzione 17, p. 394-399, April 1947.

565 Military Influence on Nuclear Research, by Andrew W. Kramer. Power Generation 52, p. 66-69, June 1948.

The military importance of atomic energy has a profound influence on the further development of nuclear research. It imposes a distasteful kind of secrecy but at the same time it provides all but unlimited funds for carrying on important nuclear research. Evidence of this fact is provided in the announcement by the Atomic Energy Commission of the construction of a new cyclotron costing nine million dollars.

SCIENTIFIC RESEARCH

566 **Poland Steps up Research.** Nucleonics 3, p. 68, July 1948

The size of Poland's atomic research group will be doubled by a decision made at Warsaw recently to put 50 additional scientists to work on atomic energy research.

SPECTROSCOPY

567 **Relative Transition Probabilities in the Spectra of Ti I and Ti II, by L. H. M. Van Stekelenburg and J. A. Smit.** Physica 14, p. 189-196, May 1948.

The relative transition probabilities of several lines in the spectra of Ti I and Ti II have been measured in emission and have been compared with the results obtained by King and King who measured the oscillator strength by an absorption method.

TRACER APPLICATIONS

568 **Detection of Intermediates, Criteria of Purity, by Martin D. Kamen.** United States Naval Medical Bulletin, March-April 1948 Supplement, p. 115-121.

Isotopic labeling techniques afford the biochemist a new and powerful approach to the elaboration of mechanisms in intermediary metabolism. The technique in its essentials involves administration of labeled substrate followed by isolation and characterization of suspected intermediates. The criterion of purity peculiar to the method is constancy of specific atom per cent of the labeling atom. By the addition of unlabeled carrier (isotopic dilution), it is possible to obtain quantitative data on the original amount of intermediate without the necessity for complete extraction. A reversal of this procedure is the basis for the quantitative analysis of biochemical mixtures. Specific illustrations of the manner in which isotopic labeling may be employed to characterize intermediates are discussed. The limitations arising from factors such as excessive dilution, inadequacy of available separation procedures, etc., are considered.

569 **An Illustration of the Power of Isotopes in a Biochemical Problem, by Vincent du Vigneaud.** United States Naval Medical Bulletin, March-April 1948 Supplement, p. 176-184.

The use of isotopic compounds in the elucidation of the mechanism of the conversion of methionine to cystine in the animal body is discussed. Evidence that only the sulfur of methionine is utilized for the synthesis of cystine has been afforded by studies in which young dehaired rats were fed synthetic methionine containing an excess of S^{34}; 80 per cent of the sulfur of the cystine isolated from the new coat of hair was derived from the dietary methionine, but no significant amount of the carbon of the cystine was isotopic. A summary of the present concept of the metabolic pathway of the sulfur of methionine to cystine involving cystathionine as an intermediate is presented.

TRACER APPLICATIONS

570 Stable Tracers in Chemistry, by Mackenzie Lounsbury. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 153-158, 1947.

The use of stable isotopes as tracers in pure and applied science is reviewed. Examples are given to illustrate the scope and simplicity of this technique in the fields of exchange reactions, reaction mechanisms, reaction kinetics and analytical chemistry. 14 references are included.

571 Tracers in Biology, by G. C. Butler. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 159-166, 1947.

The use of isotopes as tracers in biological and biochemical research is reviewed and the limitations of various techniques are considered. The isotopes of greatest use in biological and medical research are: H^2, H^3, C^{11}, C^{12}, C^{14}, N^{15}, S^{34}, S^{35}, P^{32}, O^{18}, Na^{24}, Cl^{38}, K^{42}, Ca^{45}, Fe^{55}, and I^{131}. Isotopes of C, H, and N are used in the study of intermediary metabolism; the last seven are used in tracing inorganic molecules; whereas the isotopes of S and P and to a lesser extent those of O and I are used for studying the metabolism of both organic and inorganic molecules.

TRACER APPLICATIONS, RADIOACTIVE

572 The Application of Radioisotopes to Problems of Naval Medicine, by Robert Emrie Smith. United States Naval Medical Bulletin, March-April 1948 Supplement, p. 17-27.

Radioactive isotopes have been successfully employed in tracer studies on the pharmacological properties of antimonials, with particular reference to organ distribution and exchange in animals and in man, and in animals infected with Schistosoma. Radioactive isotopes of the rare gas series have aided materially in the development of tenable hypotheses in the important field of decompression sickness and deep-sea diving. Radioactive hydrogen has been used to measure body water in vivo in animals and man. The use of neutron exposure for inducing radioactivity in prepared compounds is mentioned and brief allusion is made to radiobiological trends in the use of isotopes.

573 Are Phospholipids Obligatory Participants in Fat Transport Across the Intestinal Wall, by D. Zilversmit, I. Chaikoff and C. Entenman. Journal of Biological Chemistry 172, p. 637-650, February 1948.

Radioactive phosphate was injected into fasted dogs and 6 hours later sections from their duodenum, jejumum and ileum were removed. The specific activities of the mucosal phospholipid phosphorus and acid-soluble phosphorus were determined, and the ratios of the two values calculated. The ratios were about the same for each part of any given dog showing that the rates of turnover of phospholipid in the three parts are the same. This experiment was repeated with fat-fed dogs and similar values for the ratios were obtained, indicating that the passage of fat across the intestinal wall does not affect the turnover rate for phospholipids. The authors conclude that fat can pass through the small intestine without involving phospholipids as intermediates.

TRACER APPLICATIONS, RADIOACTIVE

574 Chemical Nature of the Bone Growth Provoked by Folliculin, by M. J. Dallemagne and J. Melon. Comptes Rendus des Séances de la Société de Biologie 141, p. 539-541, 1947.

The folliculin-induced bone growth was examined by various methods and found to be true bone, free from $CaHPO_4$. Its origin was studied with radioactive phosphorus as an indicator. Pigeons were given radioactive phosphorus (as Na_2HPO_4) subcutaneously, and estradiol dipropionate intramuscularly. The new-formed bone in the marrow cavity was examined after 20 days. Radioactive phosphorus was present in both old and new bone but it was found to be 3-5 times more abundant in the latter.

575 Influence of Folliculin on Bone Metabolism, Studied by Means of Radiophosphorus, P^{32}, by J. Govaerts, and M. J. Dallemagne. Nature 161, p. 977, June 19, 1948.

Pigeons received daily 0.15 mgm phosphorus labelled with radiophosphorus (subcutaneously) and 80 mgm phosphorus provided by a normal diet. In addition, all pigeons, except control birds, received daily 0.25 mgm estradiol dipropionate (folliculin). It appears that the new medullary bone contains seven or eight times more injected radiophosphorus than the femur of a control pigeon. It is found that nearly half the phosphorus present in new medullary bone does not come directly from phosphorus fed or injected, but from phosphorus already stored in the skeleton. The proportion of labelled phosphorus observed at the end of a 20-day experiment shows that nearly 13.1 per cent of bone phosphorus (femur) has been renewed in a pigeon receiving folliculin, but only 1.7 per cent in the controls.

576 Metabolism of a Haemorrhagic Substance; Method of Radioactive Indicators, by M. Berger, N. P. Buu-Hoi, P. Daudel, R. Daudel, and S. May. Experientia 2, p. 184-185, 1946.

Radioactive 2-bromo-3-hydroxy-1:4-naphthaquinone (obtained from 3-hydroxy-naphthaquinone and radioactive Br) was injected subcutaneously in oil suspension into guinea-pigs. The radioactivity of the blood and organs was measured and showed that the compound diffuses very rapidly (3 hours), remains for approximately 16 hours in the body, and is then excreted. Selective storage in the liver does not take place. The concentration in the blood-plasma was found to be approximately 4 times that in the red blood-corpuscles.

577 Radioactive Copper as Index of Circulation Time, by G. Schubert and W. Riezler. Klinische Wochenschrift 24-25, p. 304-307, 1947. (In German)

Radioactive Cu was used as a measure of the circulation time from one anticubital vein to the other. The very low value of 5 seconds was recorded. In vitro studies were made of the distribution of radioactive Cu between red-plasma and cells. The levels of blood-Cu after oral, subcutaneous and intravenous administration were measured.

TRACER APPLICATIONS, RADIOACTIVE

578 Radioactive Indicators; Their Application in Biochemistry, Animal Physiology, and Pathology, by George Hevesy. New York, Interscience Publishers, Inc., 1948 572 p.

579 Radioactive Tracers in Chemistry, by J. W. T. Spinks. Proceedings of the Conference of Nuclear Chemistry, Chemical Institute of Canada, p. 134-152 1947.

The wide range of problems in which radioactive tracers can be used are reviewed, and some of the difficulties encountered in their use are given. A number of applications are also mentioned. A rapid method, based on experiments carried out by C. I. Jollefson on the absorption of Ru^{++} by flour, for determining the adsorption of various ions in flour is given. The use of radioactive tracers to determine the surface area of crystals and the use of P^{32} to study the uptake of phosphate fertilizers by wheat are reviewed.

580 The Role of Nuclear Physics in Medicine and Dentistry. Part II, Use of Radioactive Tracers in the Study of Bones and Teeth, by H. Copp. American Journal of Orthodontics and Oral Surgery 33, p. 109-115, 1947.

A review of the use of radioactive tracers in the study of dental and skeletal metabolism is presented. The tracers considered are: radiocalcium, radiostrontium and radiophosphorus.

581 The Uptake of Radiophosphorus in the Phospholipid Fraction of Mouse Epidermis in Methylcholanthrene Carcinogenesis, by C. J. Costello, C. Carruthers, M. D. Kamen, and R. L. Simoes. Cancer Research 7, p. 642-646, October 1947.

The effect of methylcholanthrene on lipid phosphorus and on the uptake of phosphorus in the lipid fraction of mouse epidermis undergoing carcinogenesis induced by methylcholanthrene was investigated by the use of P^{32}. The carcinogen caused a drop of 30 per cent in the lipid phosphorus content of the epidermis, but in the carcinoma the lipid phosphorus content was nearly twice that of the normal. The specific activity time curves of normal, benzene-treated, and methylcholanthrene-treated epidermis and of the carcinoma showed no appreciable difference in the specific activities at the time of maximum P^{32} uptake. The rate of uptake in the hyperplastic epidermis and in the carcinoma was rapid, these tissues retained their labelled phosphorus for a considerable time, and both showed a similar fall in activity. The uptake in benzene-treated epidermis was at a maximum at 12 hours, while that of the normal was slower and at a maximum at 24 hours. The rate of fall in each was quite rapid and similar. Other experiments demonstrated no significant difference in the specific activities of normal epidermis or of epidermis treated 3, 6, and 12 times with benzene alone or with the carcinogen in benzene on alternate days during 10, 20, and 30 days. Although the carcinoma had a high and rapid uptake of P^{32}, its specific activity was similar to that of the treated epidermis.

TRACER APPLICATIONS, RADIOACTIVE

582 **The Use of Radioactive Isotopes as Tracers in Metabolism, by D. L. Thomson. McGill Medical Journal 15, p. 391-397, 1946.**

The applications of C^{11}, P^{32}, and S^{35} as radioactive tracers in intermediary metabolism are briefly reviewed. A note on the practical difficulties in using C^{14} is included.

583 **The Zone of Activity of Antibodies as Determined by the Use of Radioactive Tracers; the Zone of Activity of Nephritoxic Anti-Kidney Serum. by D. Pressman and G. Keighley. Journal of Immunology 59, p. 141-146, 1948.**

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TRANSURANIC ELEMENTS

584 The Crystal Structure of Cs_2PuCl_6, by W. H. Zachariasen. AECD-2088 (ANL-FWHZ-156), January 19, 1948, decl. June 28, 1948. 6 p. (For publication in Acta Crystallographica or similar journal).

Cs_2PuCl_6 is trigonal with the K_2GeF_6 type of structure. The lattice dimensions are: $a_1 = 7.43 \pm 0.01$ A; and $a_3 = 6.03 \pm 0.01$ A, giving a calculated density of $\rho = 4.10$. Plutonium is bonded to six chlorine atoms at the corners of an octahedron with Pu-Cl = 2.62 A. Cesium is bonded to twelve chlorine atoms with Cs-Cl = 3.71 A.

585 The Crystal Structure of Uranium Silicides and of $CeSi_2$, $NpSi_2$, and $PuSi_2$, by W. H. Zachariasen. AECD-2092 (ANL-FWHZ-152), January 6, 1948, decl. June 28, 1948. 17 p. (For publication in Acta Crystallographica or similar journal).

It is shown that $CeSi_2$, USi_2, $NpSi_2$, and $PuSi_2$ have the $ThSi_2$ type of structure. A second form of USi_2 is found with the AlB_2 type of structure. USi is shown to be isomorphous with FeB. The compound U_3Si_2 is found to be tetragonal and to have a structure containing Si_2 groups. The compound U_3Si is also tetragonal with a structure which can be regarded as a distorted cubic face-centered lattice. In the various uranium silicides, the coordination number for uranium is nine, ten or twelve. The interatomic distance, U-Si, ranges from 2.85 A to 3.17 A. A silicon atom is bonded to three other silicon atoms in the two forms of USi_2. In one of the USi_2 structures the silicon atoms form a three-dimensional network, while the silicon atoms form "graphite layers" in the other USi_2 structure. Infinite zigzag chains of silicon atoms occur in the USi structure, while the U_3Si_2 structure contains the silicon atoms as Si_2 groups. There are no covalent bonds between silicon atoms in U_3Si. The observed Si-Si bond distances in the uranium silicides range from 2.22 A to 2.35 A.

URANIUM

586 The Potentials of the Uranium Three-Four and Five-Six Couples in Perchloric and Hydrochloric Acids, by E. S. Kritchevsky and J. C. Hindman. AECD-2086 (ANL-WMM-341), May 1948, decl. July 1, 1948. 38 p. (For publication in the Journal of the American Chemical Society).

The uranium(III)-uranium(IV) couple is shown to be reversible at the dropping mercury electrode. From the hydrogen ion independence of the couple it is concluded that the ionic species are U^{+3} and U^{+4} in acid solutions. The reaction $U^{+3} \rightleftharpoons U^{+4} + e^-$ has a formal oxidation potential of $+ 0.631 \pm 0.005$v in molar $HClO_4$ and $\pm 0.640 \pm 0.005$v in molar HCl at 25°C. The difference in potential between the chloride and perchlorate solutions is attributed to the formation of a chloride complex of U(IV). The potential of the reaction $UO_2^+ \rightleftharpoons UO_2^{++} + e^-$ is -0.063 ± 0.004 v in molar $HClO_4$ at 25°C. Chloride ion appears to complex the uranyl and U^{+4} ions to approximately the same extent. The reduction of UO_2^+ at the dropping mercury electrode is hydrogen ion dependent in the absence of the maximum suppressors thymol and gelatin.

URANIUM

587 The Crystal Structure of $\gamma-Na_2UF_6$, by W. H. Zachariasen. AECD-2089 (ANL-FWHZ-155), January 19, 1948, decl. June 29, 1948. 4 p. (For publication in Acta Crystallographica or similar journal).

$\gamma-Na_2UF_6$ is orthorhombic. The unit cell contains two molecules and has dimensions $a_1 = 5.54 \pm 0.01$ A; $a_2 = 4.01 \pm 0.01$ A; $a_3 = 11.67 \pm 0.02$ A. The calculated density is $\rho = 5.07$. The space group is (Immm) and the atomic positions are: (0 0 0), (1/2 1/2 1/2), 2U in (0 0 0), 4 Na in $\pm$ (0 0 u) with u = 1/3, 4 F in $\pm$ (v 1/2 0) with v = 1/4, 8 F in $\pm$ (x 0 z) ($\bar{x}$ 0 z) with x = 1/4 and z = 1/6. Each uranium atom and each sodium atom is bonded to eight fluorine atoms with Na-F = U-F = 2.41A.

588 The Crystal Structure of Trichlorides, Tribromides and Trihydroxides of Uranium and of Rare Earth Elements, by W. H. Zachariasen. AECD-2091 (ANL-HDY-499), 1944-1946, decl. June 29, 1948. 14 p. (To be included in the NNES).

The compounds UCl_3, UBr_3, $LaCl_3$, $LaBr_3$, $La(OH)_3$, $CeCl_3$, $CeBr_3$, $PrCl_3$, $PrBr_3$, $Pr(OH)_3$, $NdCl_3$, and $Nd(OH)_3$ are shown to be isomorphous. They have hexagonal structures with two molecules per unit cell. The complete structures are determined and described.

589 Colorimetric Determination of Uranium with l-Ascorbic Acid, by G. G. Smith, E. F. Orlemann, A. A. Smales, C. D. Rothenberger, and W. R. Grimes. AECD-2101 (Y-53), November 7, 1947, decl. June 4, 1948. 28 p. Document for sale by AEC. (For publication in the Journal of the American Chemical Society).

Hexavalent uranium in weakly acid solution buffered with acetate ion produces with a large excess of l-ascorbic acid a yellow-brown color whose intensity is a linear function of uranium concentration up to at least 15 mg U per 50 ml. The color intensity is independent of pH in the range 4.5 to 4.8 but adjustment of the pH to 4.0 $\pm$ 0.1 is recommended to minimize the danger of slow precipitation of hydrous ferric oxide. Addition of pyridine along with the acetate buffer minimizes the interference of cupric ion. The color intensity is a function of concentration of acetate ion and of l-ascorbic acid so the amounts of these reagents used must be closely controlled.

Chloride, nitrate and perchlorate ions are without appreciable effect on the color produced. The anions such as phosphate, fluoride, sulfate, citrate, tartrate, and oxalate, which are capable of producing stable complexes with uranium in weakly acid solution, interfere with the determination of uranium by lowering the intensity of the color produced. Moderate amounts (at least 25 mg) of Fe, Cd, Mn, Na, Ca, Sn, Mg, and Th are without effect on the method. Chromium and vanadium interfere as do significant amounts of Ni, Zn, Mo, and Al.

590 Double Fluorides of Potassium or Sodium with Uranium, Thorium or Lanthanum, by W. H. Zachariasen. Journal of the American Chemical Society 70, p. 2147-2151, June 1948. (Summary of various MDDC's).

This paper summarizes the results of studies of the systems $KF-UF_4$, $KF-ThF_4$, $KF-LaF_3$, $NaF-UF_4$, $NaF-ThF_4$ and $NaF-LaF_3$.

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The systems were studied by means of the X-ray diffraction method. The systematic survey extends over the entire composition range except for a gap between 35 and 65 mole per cent ThF_4 in the $NaF-ThF_4$ system. The phases noted in each system are discussed.

591 Studies on the Electro-Oxidation of Tetravalent Uranium by R. H. Betts. Canadian Journal of Research 26B, p. 441-455, May 1948.

The conversion of uranous ion to uranyl ion at a platinum anode has been studied over a wide range of current densities and anode potentials. At high current densities, the rate of the oxidation is dependent on the uranous ion concentration and is independent of the particular current density used. At low current densities, the rate of the process increases exponentially with increases in the anode potential and temperature, but is independent of the uranyl ion concentration. It is concluded that at high current densities, the rate of oxidation is limited by the rate of diffusion of uranous ion to the anode, while at low current densities, the rate of the reaction is limited by the slowness in electron transfer between the metallic ion and the anode. A formal correlation is made between the irreversible characteristics of this system and those displayed during the electrodeposition of hydrogen and oxygen from aqueous solution.

VACUUM

592 Elements of the Vacuum System, by W. Bush. AECD-2084 (BP-33), n.d., decl. July 1, 1948. 75 p. (To be included in the NNES).

Vacuum systems capable of producing pressures below about one micron are generally classified as high vacuum systems, while those used to produce the very low pressures (10^{-3} to 10^{-5} microns) might be classified as ultra-high vacuum systems. Those of the first category constitute the subject of this paper.

Systems of the moderately high vacuum class generally consist of all or most of the following elements: (1) A high speed, high vacuum diffusion pump capable of producing the desired degree of vacuum on the high vacuum side and capable of maintaining a discharge pressure up to 20 or 30 microns. (2) A booster diffusion pump of lower speed, but capable of maintaining a discharge pressure of 100 microns or more. (3) A backing pump capable of handling the booster discharge and delivering it at atmospheric pressure. For this purpose a mechanical pump is generally used. (4) A cold thimble to supplement the high vacuum pump in the removal of water and other condensable materials from the system. Such thimbles are generally desirable in addition to the high vacuum pump. (5) In some processes where water vapor is present in abundant quantities, it is necessary to have a refrigerant trap ahead of the pump to prevent water vapor from reaching the fore-pump. The temperature of such a trap must be $-70°C$ or lower in order to be effective. (6) Miscellaneous valves, interlocks, and pressure gauges required for the correct operation and control of the system. A typical arrangement is schematically illustrated.

VACUUM

593 Adjustable Glass Capillary Gas Leak, by John H. Martin. Review of Scientific Instruments 19, p. 404-405, June 1948.

A leak whose conductance for gas is continuously variable from zero to fairly large values was developed for controlling the rate at which a gas is allowed to enter a vacuum system from a reservoir. Two models of the leak are described.

594 The Vacuum Divider; a Low Pressure Multiplier, by G. W. Monk. Review of Scientific Instruments 19, p. 396-398, June 1948. (See also MDDC-1464).

An instrument utilizing a 5-liter per second diffusion pump is described which allows pressures in the range 0.01 to 5 microns to be measured on a Pirani, thermocouple, McLeod or any other gauge ordinarily operating in the 0.5- to 50-micron range.